VOLUME LII NUMBER ONE

THE NATIONAL GEOGRAPHIC MAGAZINE

JULY, 1927

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SIXTEEN PAGES OF ILLUSTRATIONS IN FULL COLOR

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Strange Habits of Familiar Moths and Butterflies
With 44 Illustrations — WILLIAM JOSEPH SHOWALTER

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ARTICLES and photographs are desired. For material which the Magazine can use, generous remuneration is made. Contributions should be accompanied by an addressed return envelope and postage.

IMMEDIATELY after the terrific eruption of the world's largest crater, Mt. Katmai, in Alaska, a National Geographic Society expedition was sent to make observations of this remarkable phenomenon. Four expeditions have followed and the extraordinary scientific data resulting given to the world. In this vicinity an eighth wonder of the world was discovered and explored—"The Valley of Ten Thousand Smokes," a vast area of steaming, spouting fissures. As a result of The Society's discoveries this area has been created a National Monument by proclamation of the President of the United States.

AT an expense of over $50,000 The Society sent a notable series of expeditions into Peru to investigate the traces of the Inca race. Their discoveries form a large share of our knowledge of a civilization waning when Pizarro first set foot in Peru.

THE Society also had the honor of subscribing a substantial sum to the expedition of Admiral Peary, who discovered the North Pole.

NOT long ago The Society granted $25,000, and in addition $75,000 was given by individual members to the Government when the congressional appropriation for the purpose was insufficient, and the finest of the giant sequoia trees of California were thereby saved for the American people.

THE Society is conducting extensive explorations and excavations in northwestern New Mexico, which was one of the most densely populated areas in North America before Columbus came, a region where prehistoric peoples lived in vast communal dwellings and whose customs, ceremonies, and name have been engulfed in an oblivion.

TO further the important study of solar radiation in relation to long-range weather forecastings, The Society has appropriated $60,000 to enable the Smithsonian Institution to establish a station for four years on Mt. Brukkaros, in Southwest Africa.

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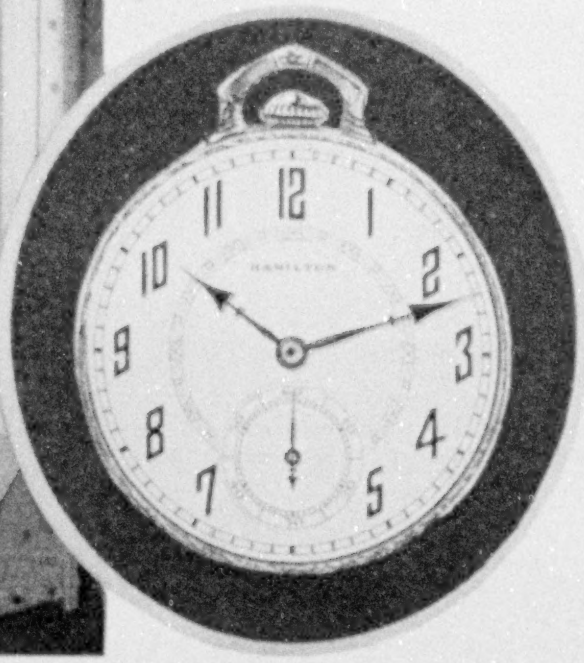

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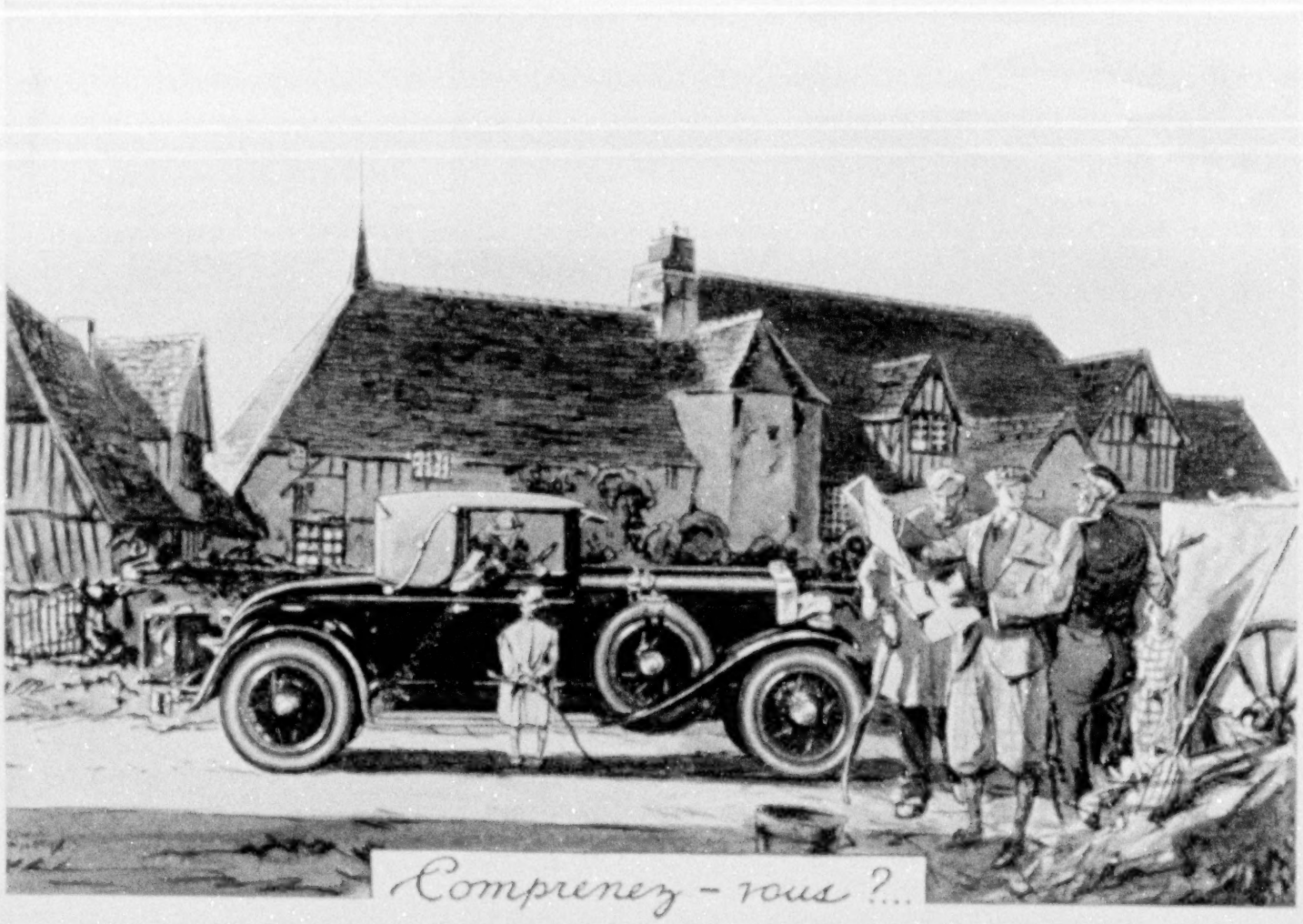

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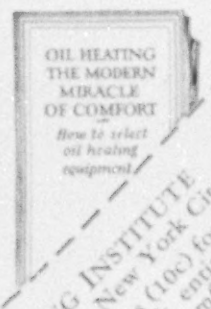

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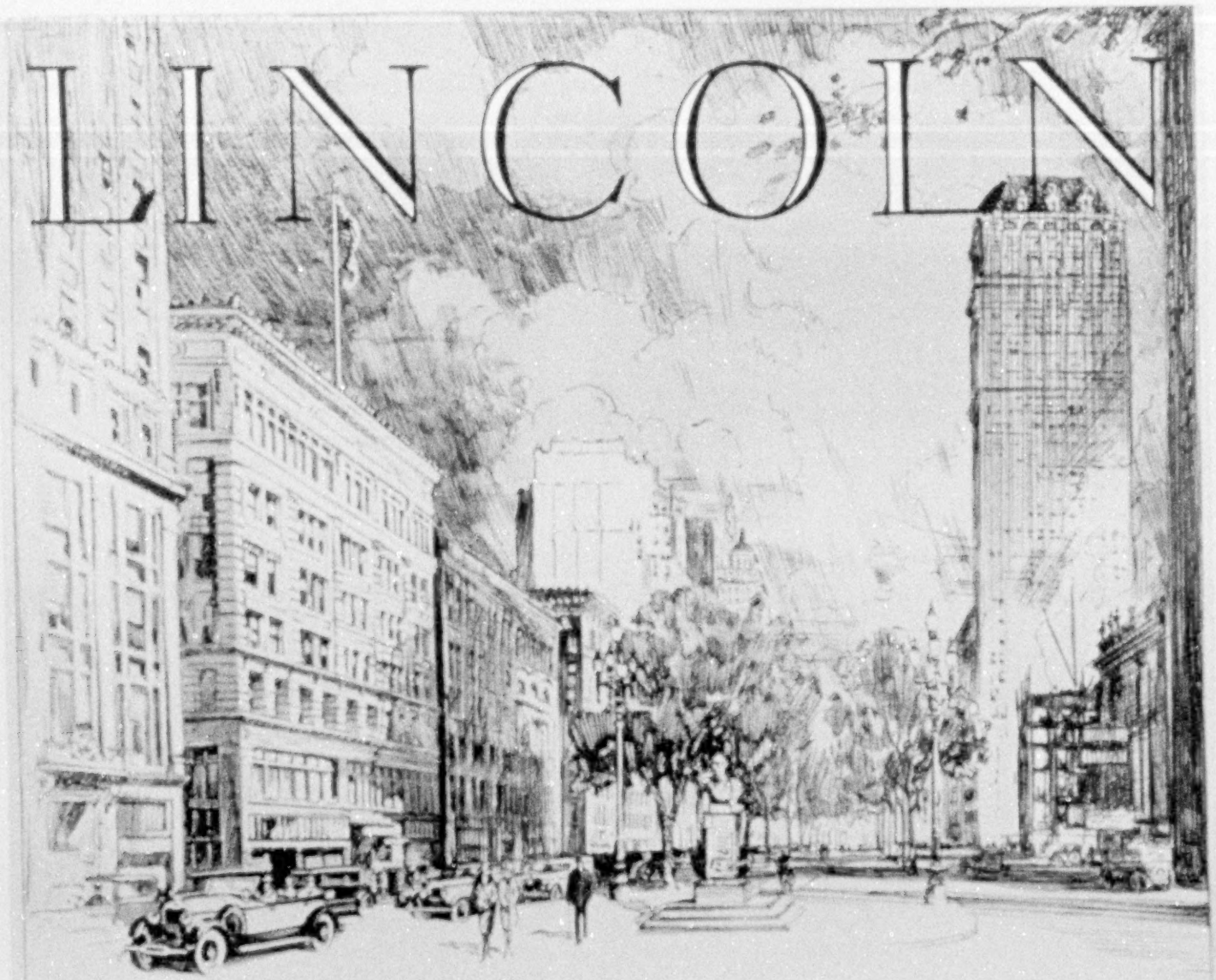
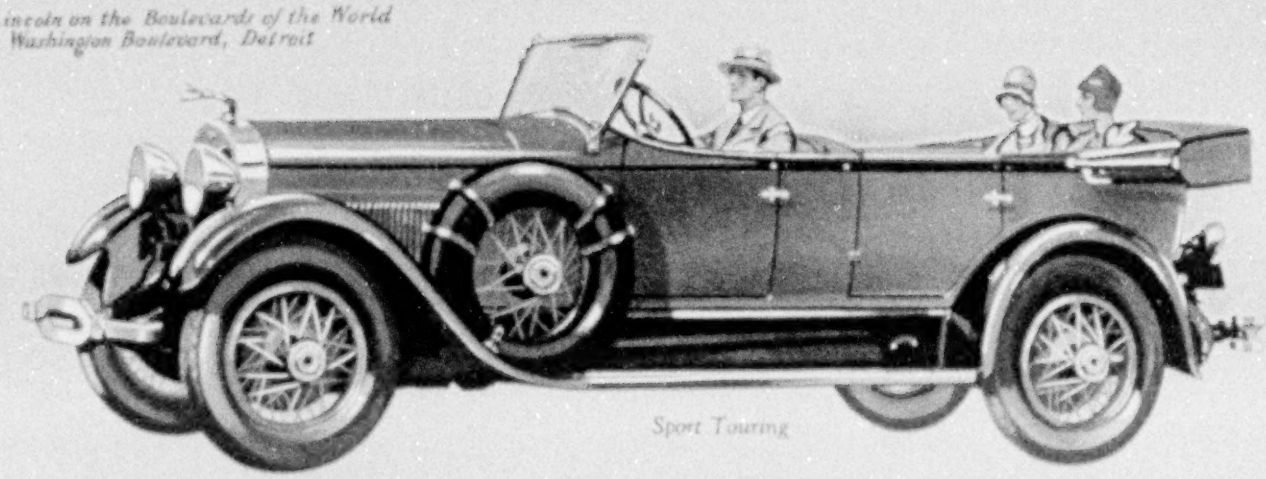


The Lincoln on the Boulevards of the World
Washington Boulevard, Detroit



Sport Touring

¶ Here is a most attractive car—its distinctively Sport lines accented by the Lincoln moulding treatment and creating an effect of long, low, yacht-like beauty. ¶ The one-piece windshield, of the ventilating type, is ideally adapted to this body design, affording most excellent vision. Wide doors, opening toward the front, give easy access. Seats are placed to give the utmost restful comfort. Choice of color combinations; grain leather upholstery in soft, neutral brown. ¶ As with all Lincoln body types, the Sport Touring is of custom design.

LINCOLN MOTOR COMPANY
Division of Ford Motor Company

DOES YOUR WATCH HARK BACK TO THE FLORODORA DAYS?

A watch may never lose a second yet be many years slow

An old watch has many tales to tell but they are only for the ears of him who wears it. In the eyes of others it is just a watch—old-fashioned and out of style. And by that watch you are often judged, or misjudged, as a man of yesterday. At your jeweler's is a watch more in keeping with your present business and social status . . . a modern Elgin Watch. Sixty years of experience have been concentrated in it, to the one end that Elgin Watches may be truly fine and faithful.

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YEARS before its appearance, Dayton's engineers and chemists heralded the introduction of the balloon by developing the Dayton Thorobred Cord—*the pioneer low air pressure tire.* And today the Dayton *Stabilized* Balloon—the product of these same engineers and chemists—is equally revolutionary.

Stabilized construction absorbs road shocks and distributes wear evenly. Flat, center traction tread has complete four-point road contact. No singing, no rumbling. Quick-grip, quick-release, non-skid gives lightning "get-away" and perfect safety at all speeds. Stabilizing bands of friction rubber draw the center of tread parallel to center of rim, thus preventing "shimmying." The rubber is especially compounded and tempered—by an *exclusive* Dayton process. It is strong and durable—and will outlast extra thousands of miles of toughest driving.

You can ride more miles, faster miles, cheaper miles and easier miles on Dayton *Stabilized* Balloons. Ask anyone who uses them and they will tell you this is true. Go to the Dayton dealer near you and examine a Dayton *Stabilized* Balloon. You'll see a truly great tire value!

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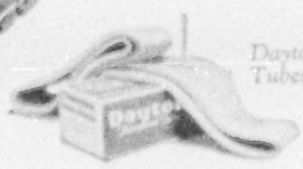
Dayton *STABILIZED BALLOONS

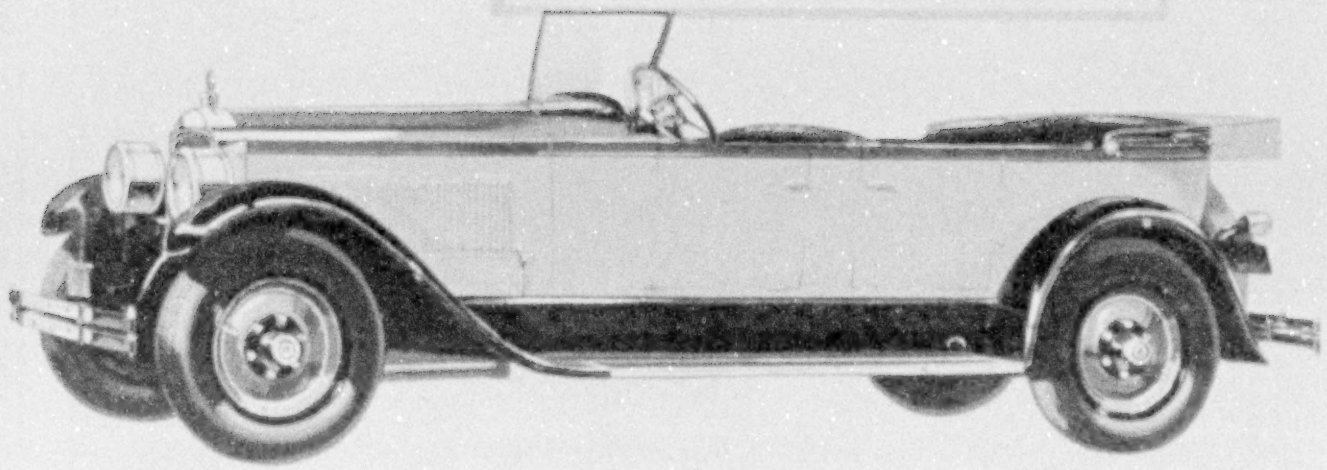
ON WHEELS OF LARGE DIAMETER—install Dayton Thorobred Cords—superlative tire values that smash all mileage records. The Dayton Thorobred is *the pioneer low air pressure tire*—the first to combine comfort with safety and endurance.



Dayton Thorobred Extra-heavy Tubes. Grey—of finest rubber. Red—of purest antimony. Steam-welded and reinforced at valve base. They will hold air.

The Restful Car

"The supreme combination of all that is fine in motor cars"



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Thousands of families have not been without the faithful service of a Packard for a generation.

To these and many other families of more recent ownership Packard cars have come to mean far more than fine, efficient machines of transportation. They have gained some part of that affection men feel for faithful dogs and high-bred horses.

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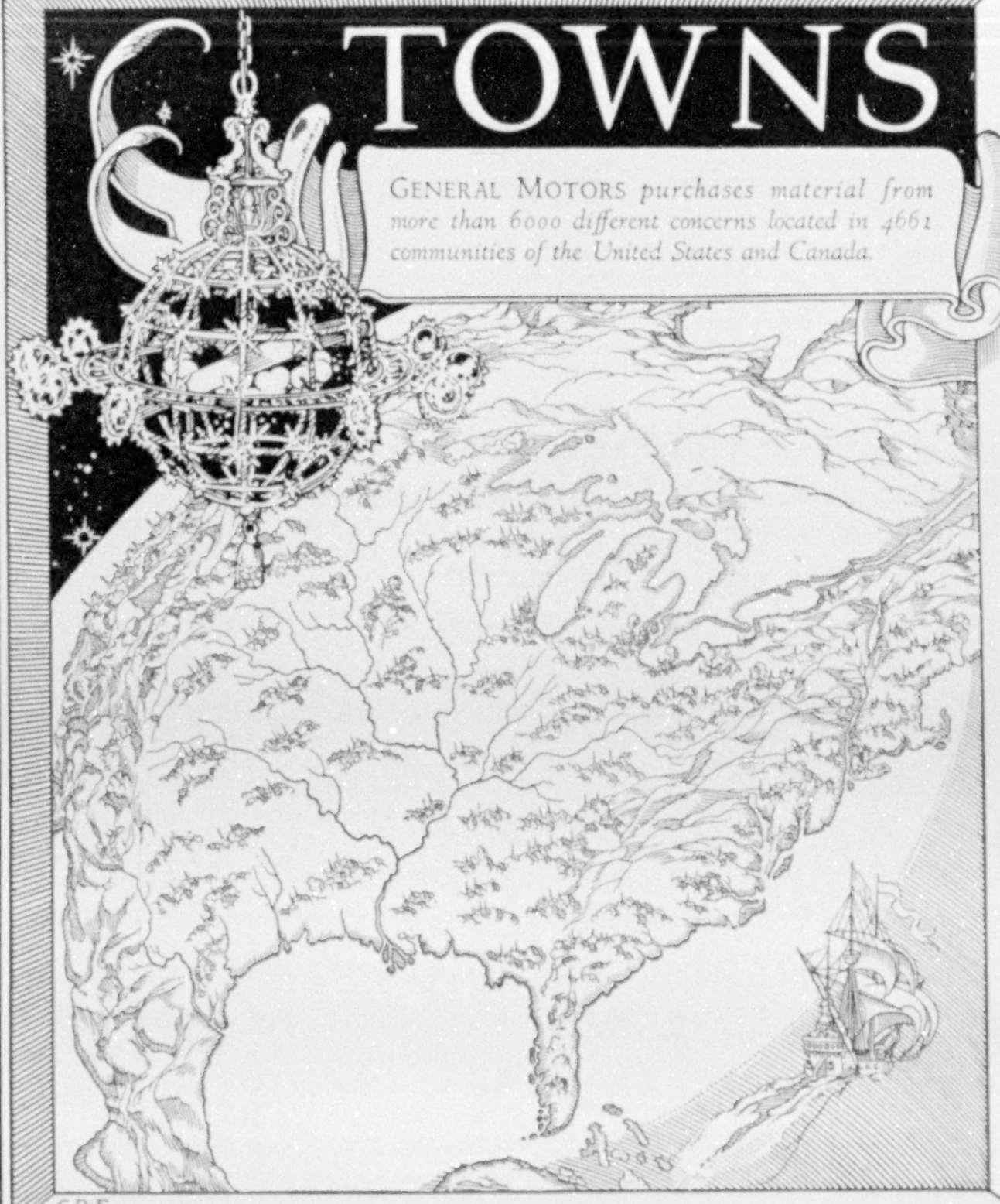
The famed beauty and distinction of the Packard, its roomy comfort, great power and long life—all have had a part in establishing its priceless reputation. But underlying all these is the Packard dependability which for twenty-seven years has made the name Packard synonymous with quality motor cars.

ASK THE MAN WHO OWNS ONE

PACKARD

TOWNS

GENERAL MOTORS *purchases material from more than 6000 different concerns located in 4661 communities of the United States and Canada.*



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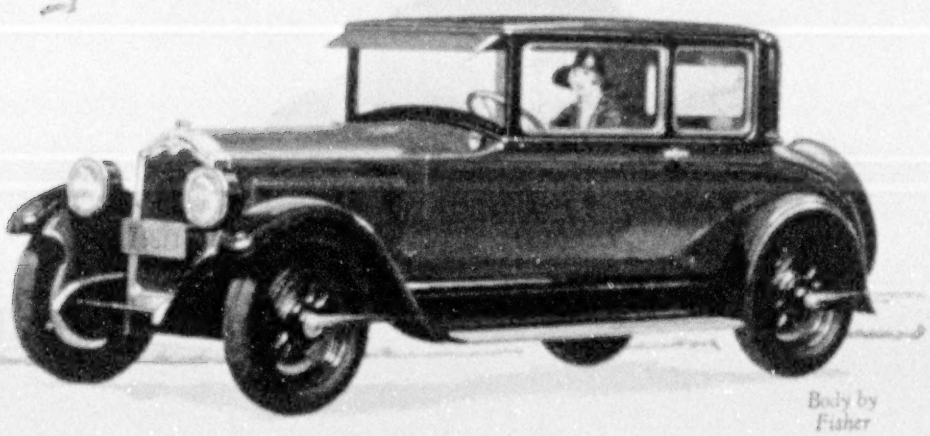


Body by Fisher

Everything a motor car can offer

Beauty

Trim, graceful lines; charming proportions; rich Duco colorings; restful, tasteful interiors; upholsteries fine in appearance and in quality; the painstaking, enduring coachcraft of Fisher—Buick combines them all in a car of rare and unusual beauty.

Performance

Buick's six-cylinder Valve-in-Head engine is *vibrationless beyond belief* at any point on the speedometer. It has power to take you anywhere, speed that eats up miles, and flexibility that makes driving amazingly easy, even in the thickest traffic.

Comfort

Ample wheelbase and cantilever springs; specially constructed seat cushions, properly tilted at the most inviting angle; roomy, convenient seating arrangements—Buick provides comfort for driver and passengers.

Economy

Low fuel costs with the efficient Buick engine; only four oil changes a year with the Vacuum Ventilator; increased tire mileage with Balanced Wheels; dependability and long life—these are examples of Buick economy.

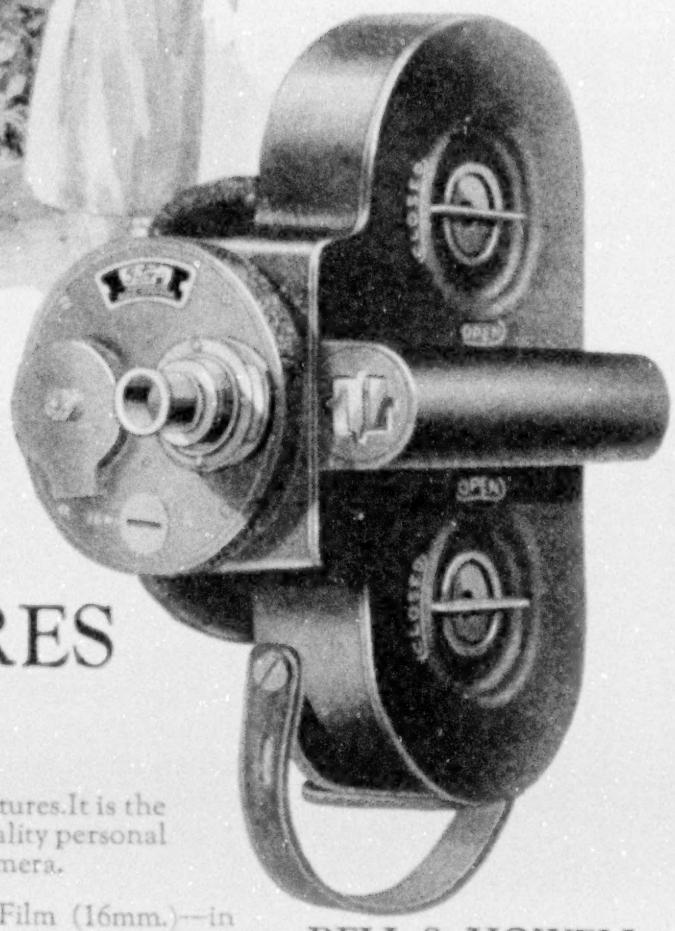
Value

Because Buick uses the earnings of leadership to further enrich Buick quality; because Buick constantly strives to improve and refine its product; because Buick gives everything a motor car can offer—in greater measure, at moderate cost—Buick is today the greatest value automobile dollars can buy.

WHEN BETTER AUTOMOBILES ARE BUILT, BUICK WILL BUILD THEM

Buick

Professional Accuracy with Amateur Ease



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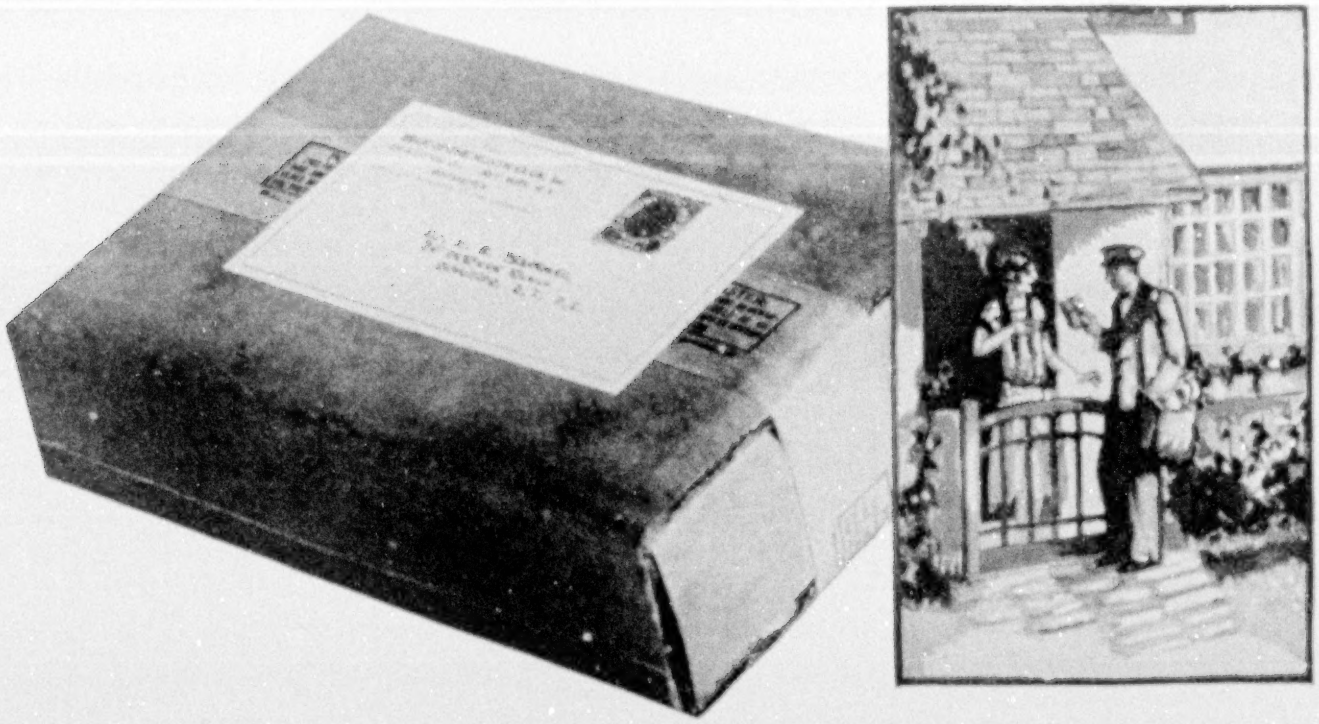
New York, Hollywood, London . Established 1907



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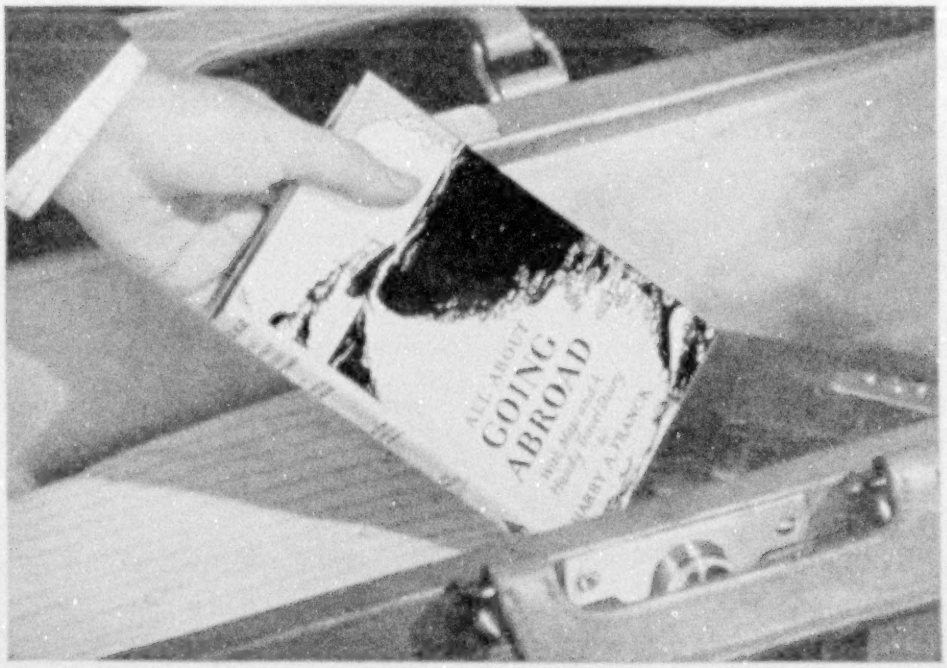

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In addition, the Ponsell Floor Machine takes care of your other floors. It gives linoleum a luster surpassing anything you have ever known...a surface so immaculately smooth that dust and dirt have a hard time sticking to it. The machine scrubs tile, cement, or any other kind of floors as they never could be scrubbed by hand, and without the least splashing.

We have branch offices in 24 cities ready to serve you. Upon request, we offer a FREE demonstration in your own home. Or if you are too far from our nearest branch, a 10-day FREE trial. But first write for a complete description of this marvelous little machine, and what it does. Tear off the coupon now as a reminder, and then mail to us. We promise you an answer promptly.

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Please mail me complete information and prices regarding your Electric Floor Machine. This does not obligate me in any way whatever.

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The volume of freight traffic which the railroads of the country were called upon to handle between 1916 and 1926 increased 23 per cent. In the same period the freight traffic which the Southern Railway System was called upon to handle increased 48 per cent.

The Development Service of Southern Railway System, Washington, D.C., will gladly aid in securing industrial locations, farms and home sites in the South.

Eggs in many baskets

Thanks to the variety of Southern soil and the favorable climate, probably no other similar area on earth can show a greater range of products.

Cotton, it is true, is the South's largest crop, but the value of cotton and cotton seed amounts to only 25 per cent of the total value of Southern agricultural products, which last year exceeded three and one-half billion dollars. There are also corn, tobacco, wheat, and a wide variety of fruits and vegetables—all east of the Mississippi and south of the Ohio.

The average farm in the South is one of about 70 acres. On this the Southern farmer can plant cotton, grow grain and raise tobacco, fruits, vegetables, and dairy herds and poultry.

This diversity yields him a stable income—he has his eggs in many baskets.

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RAILWAY SYSTEM

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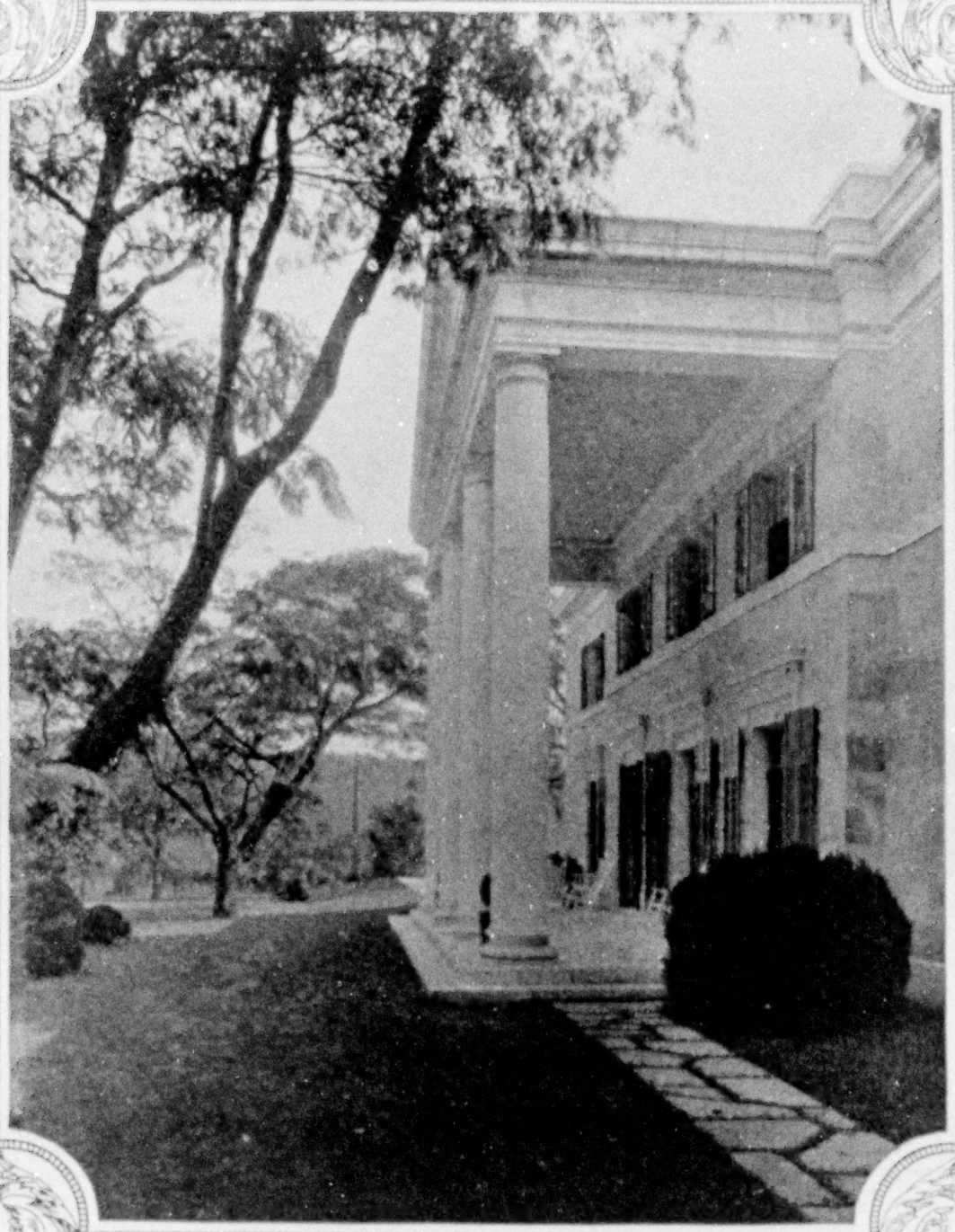
"Build thee more stately mansions, O my soul,
As the swift seasons roll!"



"MORE STATELY MANSIONS"

Of delicate pink Georgia Marble, with contrasting white columns, the stately mansion of Colonel Sam Tate, typically Southern in architecture, blends softly with the beauty and majesty of its setting in the North Georgia Mountains.

The Georgia Marble Company, Tate, Ga.

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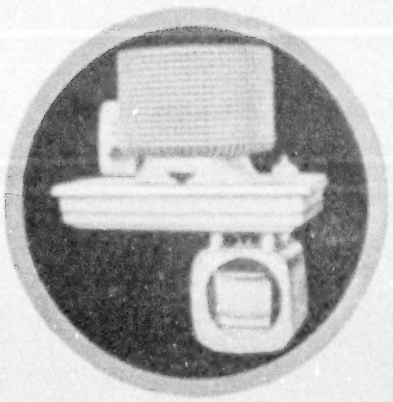

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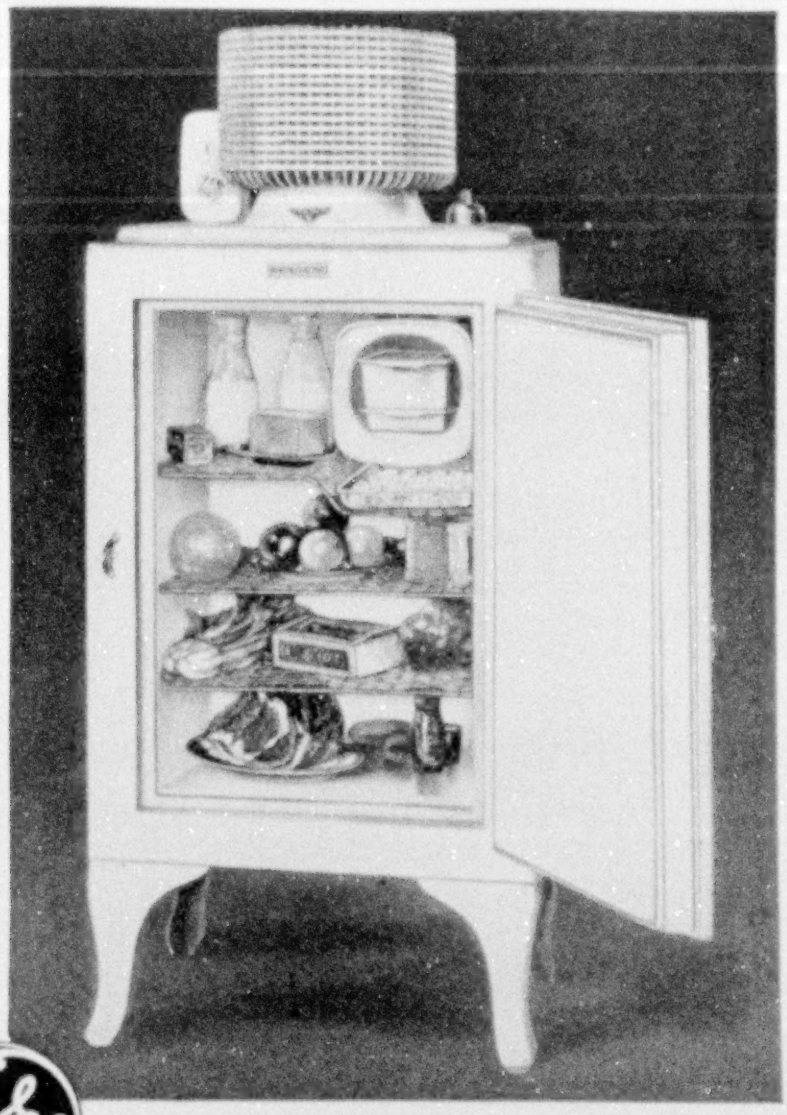

G-E Refrigerator

HERE is a new development in electric refrigerators for the home that every person interested in a refrigerator will want to see—the creation of General Electric.

It marks an entirely new conception of electric refrigeration. It marks an entirely *new* type of icing unit.

The entire mechanism of the General Electric Icing Unit is housed on top of the cabinet in one hermetically sealed casing. (Note illustration.) That is *all* the mechanism—none below the box, none in the basement. There are no pipes, no drains, no attachments. All bulky machinery is eliminated—virtually all servicing. Operating automatically, you need never touch it—never oil it.

The result of fifteen years of intensive research

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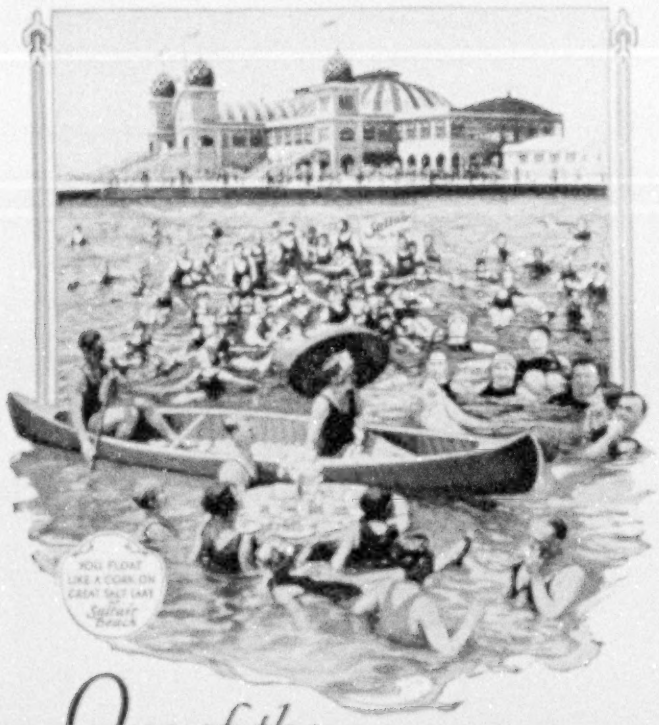
It has reduced electric refrigeration to a point of *simplicity* which makes it almost as easy to operate as an electric fan—and almost as portable. You may place it anywhere—move it anywhere. Just plug it into any electric outlet and it starts.

The General Electric Refrigerator is unusually quiet. It is always clean because the circulation of air through the coils prevents dust from settling.

You will want to see this refrigerator. But, meanwhile, send for booklet No. 7-N which tells all about it, including the various sizes which are available.

Electric Refrigeration Department
of General Electric Company
Hanna Building, Cleveland, Ohio

GENERAL ELECTRIC



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I am planning to visit Salt Lake City and would like to know more about the subjects checked.

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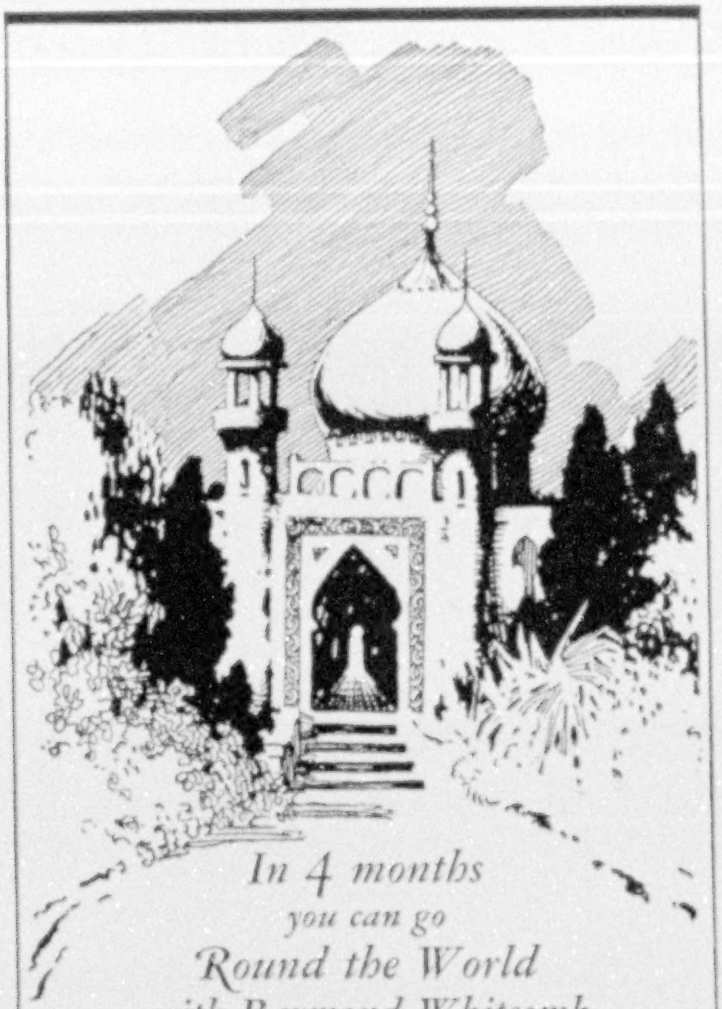

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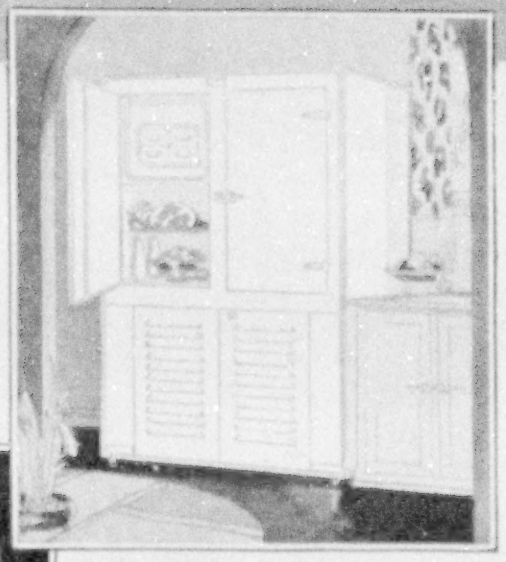
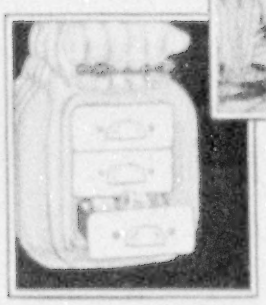


See the new Frigidaire models at the nearest Frigidaire Salesroom. Steel cabinets, made in the Frigidaire factory, with hydrolene-treated insulation that keeps heat out and cold in. Direct frost-coil cooling that maintains a constant cold-storage temperature in the food compartment—self-sealing freezing trays in which to make ice cubes and an endless variety of frozen salads and desserts.



Therein lies the importance of looking for the nameplate "Frigidaire—Product of General Motors" on the cabinet of the electric refrigerator that you buy. It is your guarantee of General Motors quality in every detail of construction; your assurance of unfailing service in every phase of operation. Already hundreds of thousands of users have been won to Frigidaire—*more than have bought all other electric refrigerators combined.*

Yet the cost of Frigidaire is surprisingly low. A small deposit puts it in your home. Then pay a little each month under the liberal General Motors terms.

Visit the Frigidaire Salesroom nearest you. Or write for an interesting illustrated booklet—sent free.

FRIGIDAIRE CORPORATION

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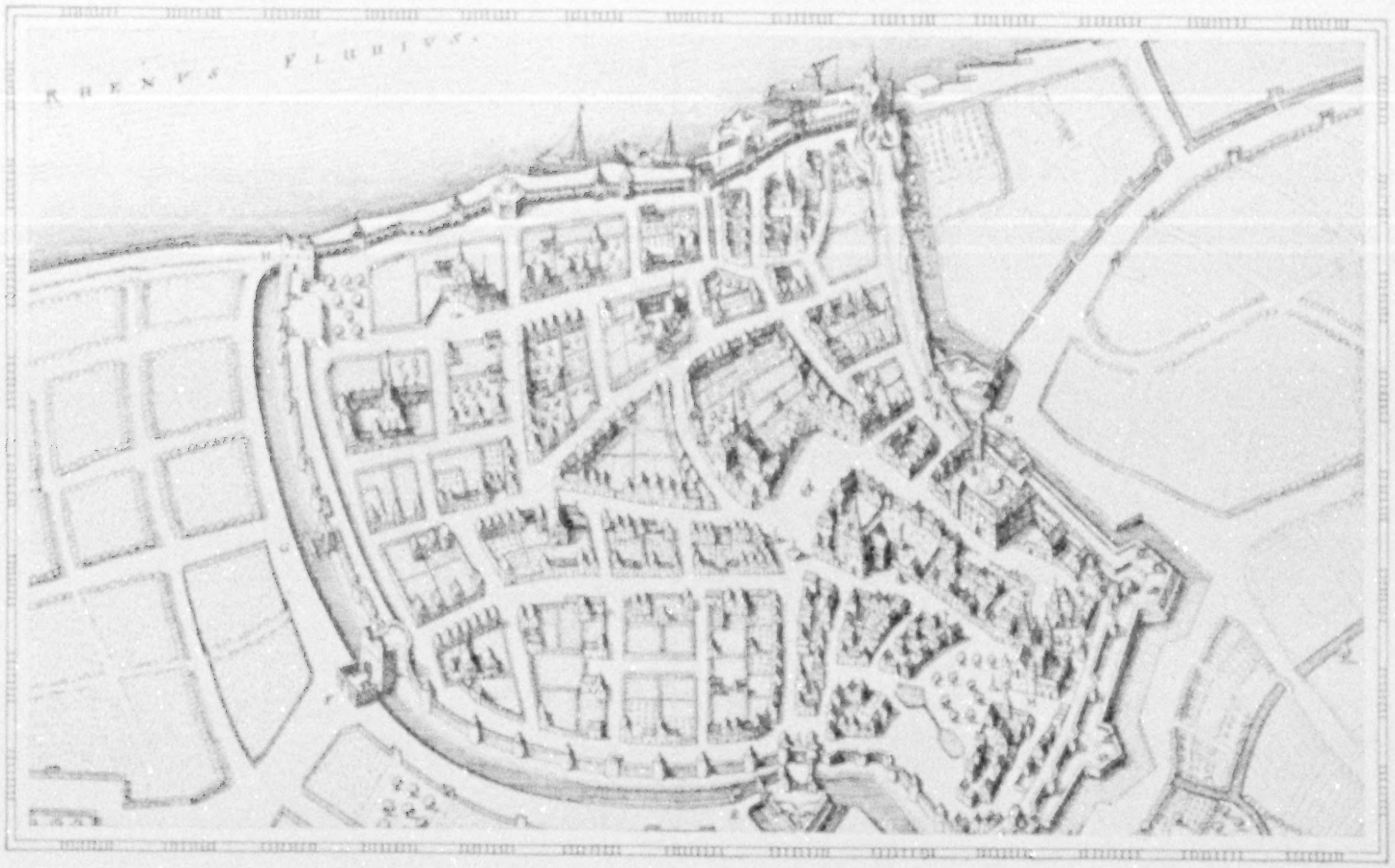

A Seventeenth Century Guide *to the city of Bonn*

Rand McNally Auto Road Maps are the most widely used in America. There is one for each state, showing roads, with road markings, condition, type of pavement, turns, curves, and crossings. Populations of cities and towns are given, with an index in the margin. Each map is folded in a booklet containing detailed and up-to-date city maps, with the latest hotel and garage information, motor laws, etc. Obtainable at leading booksellers', stationers', drug stores and news stands. Write for descriptive booklets

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Population Maps	City Guide Maps

A COMBINATION of map and bird's-eye view is this seventeenth-century guide to the city of Bonn and its environs. It is an exquisite piece of patient draftsmanship. But the subject was hardly a difficult one for the map maker to render.

He found it no great task to collect his data. He was, in all probability, a native of the town and knew by heart every house and tree and stone.

More than that, he had known them, just as he has represented them here, ever since he was a child. For not a dozen changes had taken place in the town for perhaps a century.

Today, and on our more energetic continent, what a difference!

No matter how restricted the area in question, changes are continually taking place. A map becomes out of date in a very short time.

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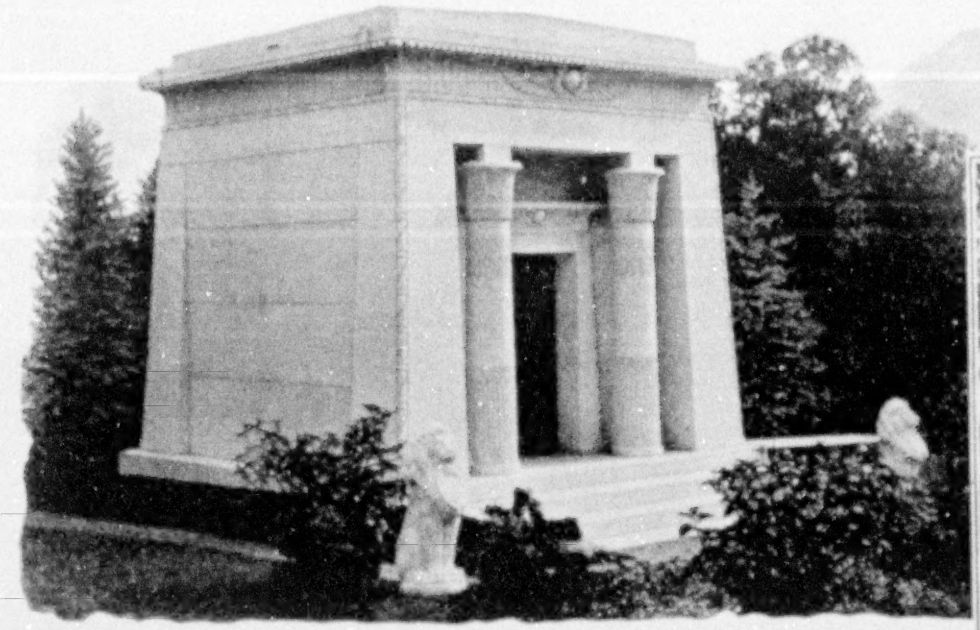
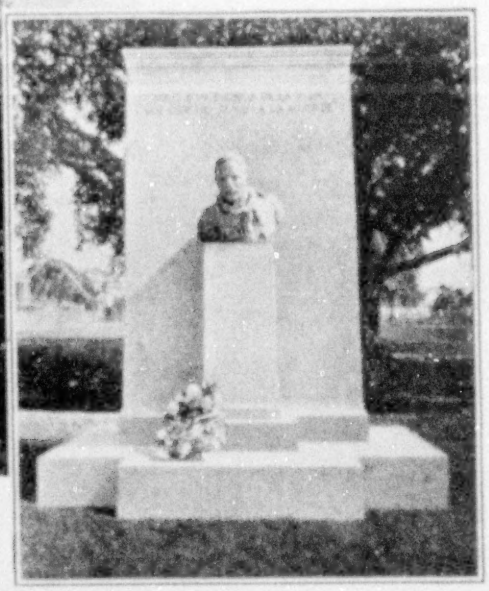


Egyptian architecture characterizes this mausoleum of Victoria White Granite. It is located in Sleepy Hollow Cemetery, Tarrytown, N. Y.



The Roosevelt memorial erected by the Rotary Club of Santiago, Cuba, and built of Stony Creek Granite.

THE Commander of the "Rough Riders" continually receives recognition. For service rendered in Cuba the Rotary Club of Santiago has erected a memorial. Stony Creek Granite was used because of its harmony with bronze and its everlasting wearing qualities.

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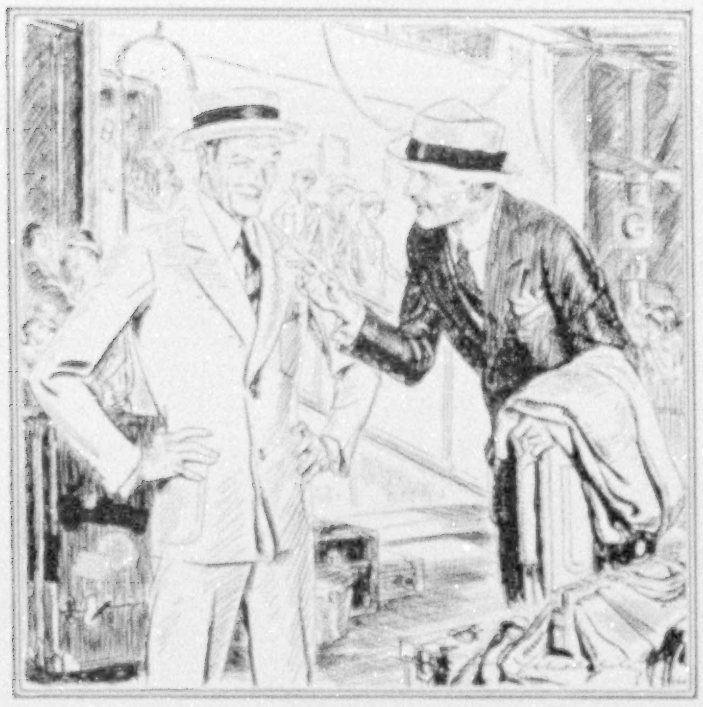

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"YOUR trip evidently did you a world of good. What happened?"

"Big specialist ordered me abroad to a water-cure place to drink water—lots of it—no medicine—just water. I drank gallons and gallons during the weeks I was there. Counting steamers, railroads, hotels and doctors, that water must have cost $10 a glass but it was worth every penny. It worked miracles for me. What are you laughing at?"

"Laughing at the price you rich men pay for miracles. While you were away my doctor ordered me to drink water, too. Lots of it—8 glasses every day. Told me to have my prescription filled straight from our own faucet. And I never felt better in my life."

IT is a curious fact that some people cannot be made to realize the value of drinking water freely unless they pay a big price for it. Yet pure water—drunk as regularly at home as it is taken at the spas—will often produce health "miracles". Nowadays good doctors agree that almost everybody, except those who need a specially selected diet, should drink water regularly—one glass before breakfast, one in the forenoon, one in the afternoon, one before going to bed, and one with each meal—six to eight glasses a day.

More than two-thirds of the weight of the body is water; water forms the bulk of the blood. If the blood does not get the water it needs—either as a beverage or in food—it will absorb water from the tissues of the body and be overloaded with harmful waste products as well.

Poisons produced by the body are eliminated largely by means of the water we drink. If too little is taken, they tend to remain in the body.

This summer you probably will be motoring, hiking, or camping out in the country. Take care that the water you drink is pure. Sometimes those cool and inviting brooks, springs and old wells carry deadly typhoid germs.

To be safe, before your summer trips begin, make an appointment with your doctor for inoculation against typhoid fever. It is a simple matter and gives immunity for a period of two or three years.

To keep in the best physical trim at home or abroad, drink plenty of Nature's marvelous health-giver—pure water.

Medical experts warn us that those who neglect to drink sufficient water will eventually pay the penalty. Symptoms of digestive disturbance, headaches, muscular and neuralgic pains, dullness, inertia and intestinal stasis—may result from drinking too little water.

Metropolitan Life statisticians report that while typhoid scourges have practically disappeared in large cities and in other places where the water supply is protected, typhoid is still a menace in many rural areas and wherever the water becomes contaminated.

Typhoid can be stamped out. Send for the Metropolitan Life Insurance Company's free booklet "The Conquest of Typhoid Fever". Learn how to protect yourself and your family from water which may be unsafe.

HALEY FISKE, *President.*

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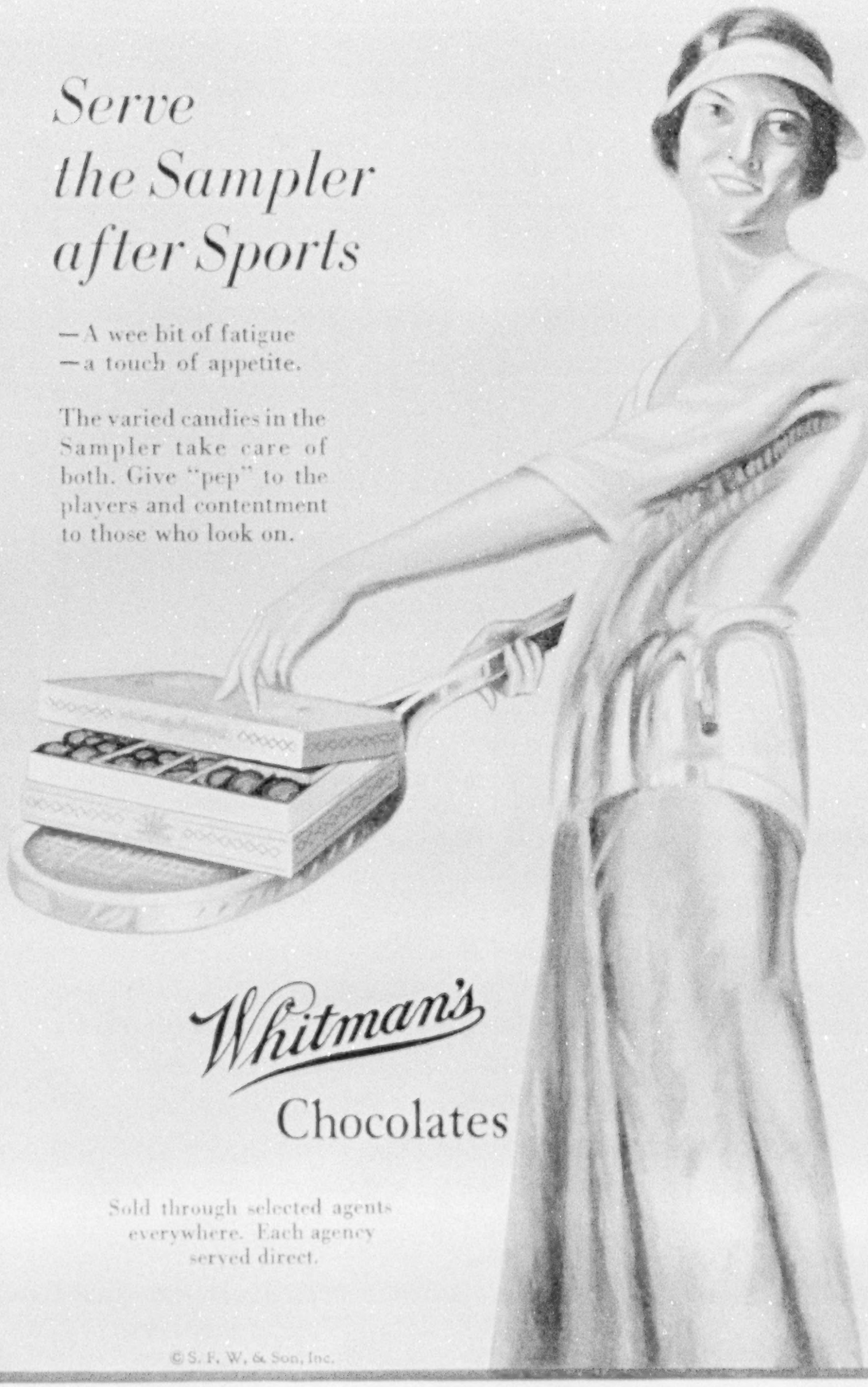
The varied candies in the Sampler take care of both. Give "pep" to the players and contentment to those who look on.



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VOL. LII, No. 1 WASHINGTON JULY, 1927

THE NATIONAL GEOGRAPHIC MAGAZINE

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SINDBADS OF SCIENCE

Narrative of a Windjammer's Specimen-Collecting Voyage to the Sargasso Sea, to Senegambian Africa and Among Islands of High Adventure in the South Atlantic

By GEORGE FINLAY SIMMONS

CURATOR OF ORNITHOLOGY, CLEVELAND MUSEUM OF NATURAL HISTORY, LEADER OF THE MUSEUM'S SOUTH ATLANTIC EXPEDITION, 1923-1926

With Illustrations from Photographs by Members of the Expedition

MANY an Anglo-Saxon is sea rover and pirate at heart and longs to wander and seek the queer animals of the earth. To go down to the sea in wooden ships, after the manner of the adventurous Phœnicians and the hardy Portuguese, is the dream of the eternal boy. And all through the ages we shall still have the appeal of pirates and pieces of eight, of the Jolly Roger and the Spanish Main, and of wooden ships and men of iron.

Civilization, however, has driven piracy from the seas, and maritime commerce has become almost too mechanical through constant regulation. Now few opportunities remain to ship before the mast. There are the scattered banks fishing fleets, a few racing yachts, a coasting vessel or two, and there is the treasure ship seeking the treasures of natural science—gems from Davy Jones's locker, strange trove from untrod isles, living jewels from the coffers of Madame Pandora.

Huxley cruised the Australian waters in the *Rattlesnake;* Darwin went on a protracted voyage around the world in the *Beagle;* Wallace explored the Malay islands and the Amazon in small boats, and Wyville Thomson and Moseley and John Murray studied the sea and its islands and shores from the decks of the *Challenger.*

Steam came into use in exploration with the *Challenger,* which proceeded principally by sail and set an example for the Earl of Crawford's *Valhalla,* Robert E. Peary's *Roosevelt,* Captain Robert Falcon Scott's *Discovery,* and Shackleton's *Quest.* Steam alone propelled the *Albatross* for Agassiz and the *Valdivia* for Chun; they moved quicker, but had to return home sooner.

The task of these nautical naturalists was to make the sea and its distant isles give up their secrets. The key to their scientific problems is found in specimens slowly amassed under carefully observed conditions.

Once the doors of marine mysteries are unlocked, then man will feel more confidence in his ability to master Nature. Light will also be cast on the problems of continental plant and animal distribution, on the methods and results of evolution,

Photograph by Oliver F. Holden

"EAST OF THE SETTING SUN": THE BEGINNING OF A VOYAGE OF TWO AND A HALF YEARS

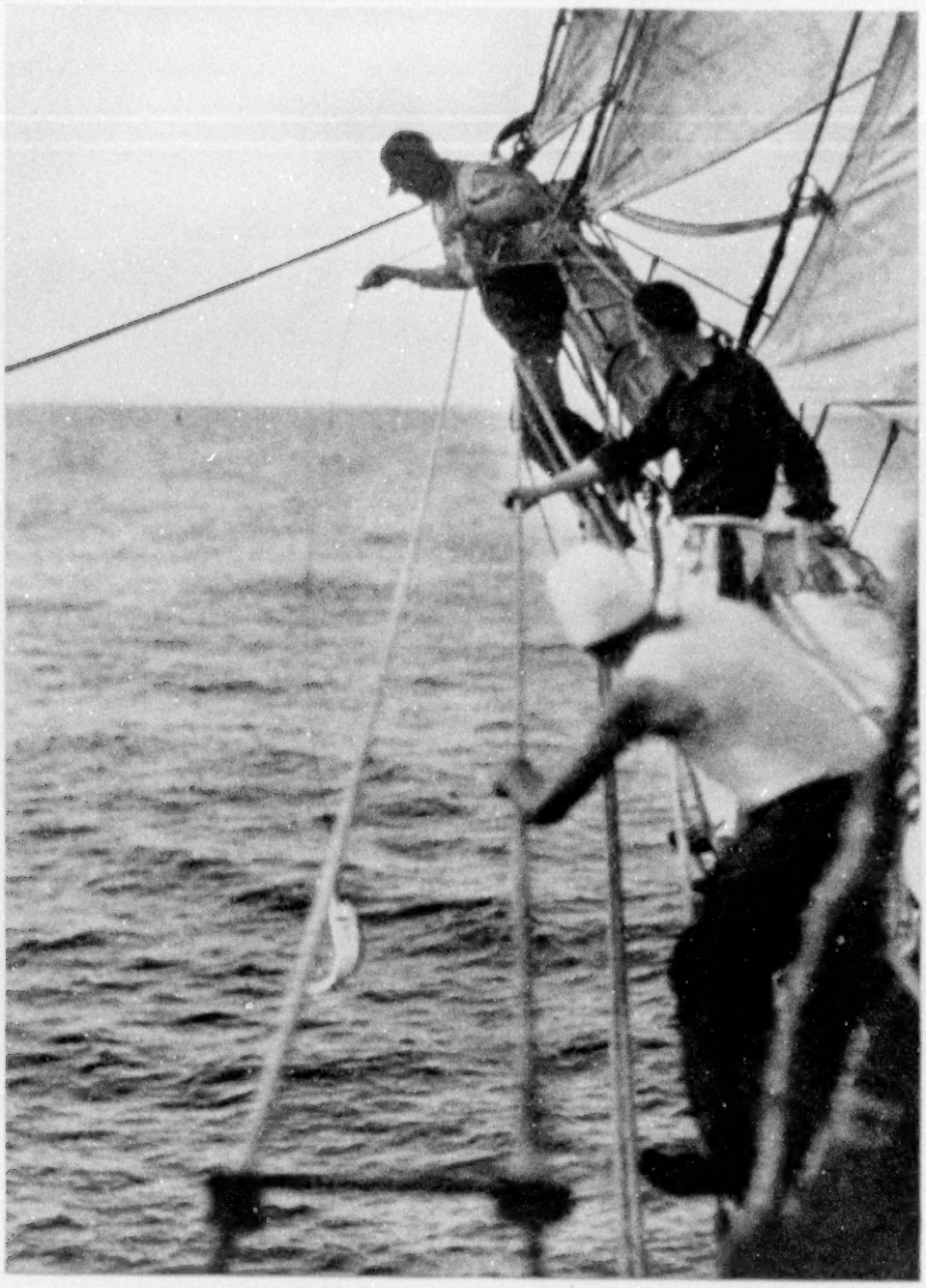
The *Blossom*, towed down to an anchorage in Gardiners Bay at the north end of Long Island, restowed her equipment and stores before putting to sea (see text, page 10).

and on possibilities of improving man and his domesticated plants and animals.

NEPTUNE'S SEA-BITTEN STEPSONS

All of this past was ours, as we planned the Cleveland Museum's South Atlantic Expedition. We were eager for the sight of the strange birds and animals needed in our collections, and we openly admitted that we longed for adventure on the decks of our little windjammer headed for foreign lands.

Of our original party of sixteen, only four were to return at the end of two years and a half; for we changed crews twice, sending men home ill with African fevers or worn with exposure and the dull monotony between islands, while we were spending 250 days under sail, logging 20,000 miles.



Photograph by Geo. Finlay Simmons

HOOKS BAITED WITH SILVER

Long John clung to the schooner's bowsprit and fished for the golden dolphin, hoodoo fish of the deep-sea sailor.

It has been well said, of organizations running the alphabet from *a* for army to *y* for yacht, that a cook is more important than a captain. Now, I always stood on the good side of William Hall, for he was the cook, and by force of circumstance I was only the captain. W. Kenneth Cuyler, big, red-headed biologist in charge of field collecting, and "Long John" da Lomba, who knew ships and the sea, also stood well with William; so they, too, completed the cruise.

William cooked, fished for specimens, and at times skinned birds. Cuyler ranged and clambered, studied and collected, and helped Long John with the ship and the boats; and Long John himself—well, John looks more like a pirate than even "a pirate right out of a book." However, in spite of the silver earrings which he sometimes wears, John is anything but a pirate; perhaps once a "buckaroo," when he strode the decks as chief mate of the famous whalers *Daisy* and *Chas. W. Morgan*. Now he is gentle and kindly; but even with the passage of years he will never forget how to handle a whaleboat through bad surf or in front of wave-beaten rocks in mid-ocean.

A CHALLENGE TO MARITIME SUPERSTITION

We took the albatross, the golden dolphin, Mother Carey's chicken and Mother Carey's goose, Pharaoh's chicken, griffons

Photograph by Geo. Finlay Simmons

LONG JOHN GLOATING IN THE FACE OF A HOODOO

For many centuries mariners have frowned at the catching of the beautiful, changing-hued dolphins, alleged to bring luck and fair winds to the sailing ship (see text below).

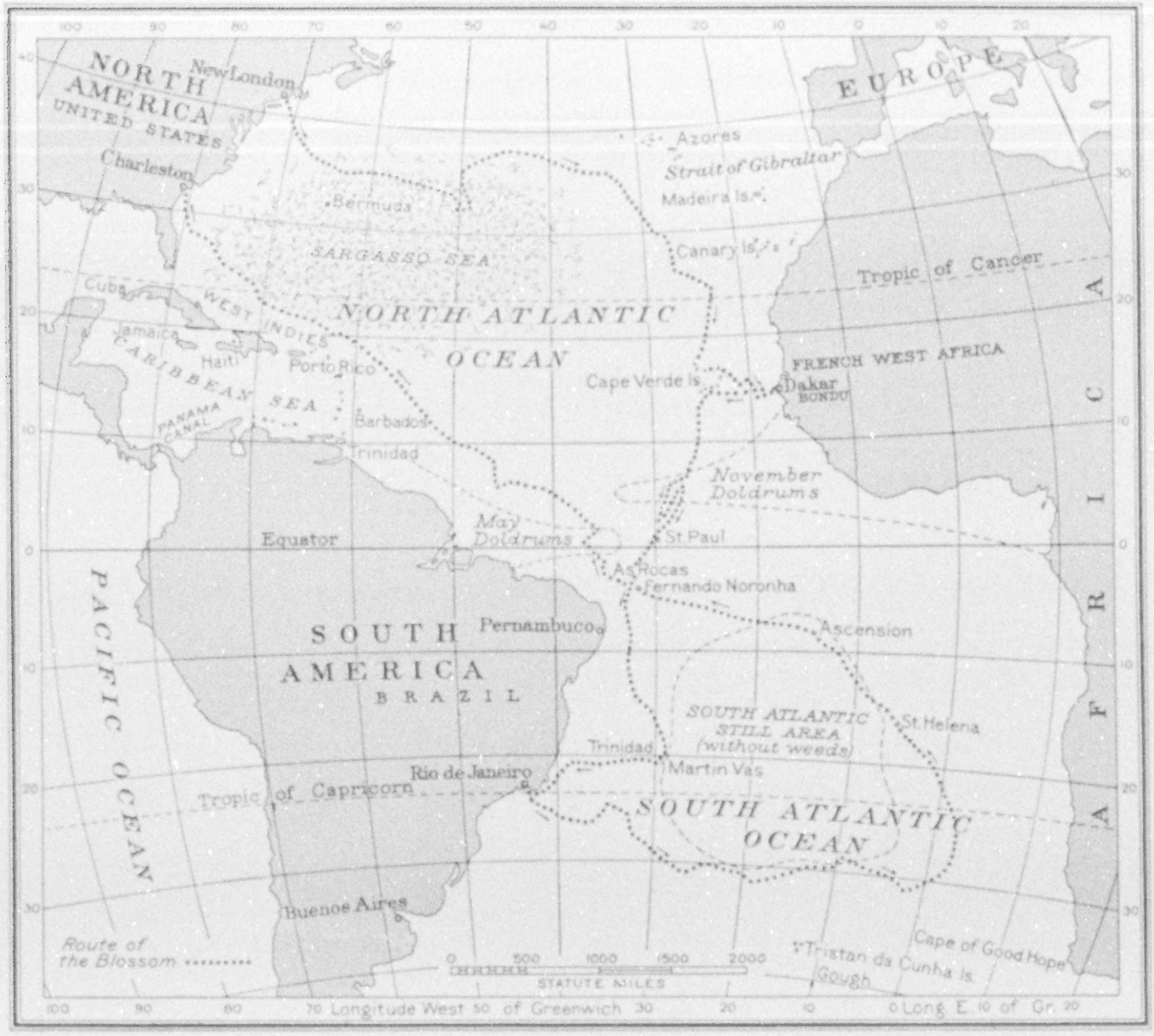
and sea serpents, and many other animals of fable and antiquity. The violent death of some of these is considered by mariners to be a sure way of bringing trouble on one's head. And when one starts out avowedly to hunt for trouble he usually finds it.

Thus did our men explain why ill luck dogged our schooner's wake. We met storms, head winds, and disheartening calms; men were sick from fevers and exposure, usually when they were most needed; our small boats were battered on hidden reefs and iron-bound shores, and one whaleboat was wrecked in making a difficult landing. In distant ports, of Africa and South America, there were wearisome delays while the schooner underwent the repairs always needed after many months at sea.

Fortunately, the tragic drama at times became melodrama and even light opera—a background of native huts with too much covering and native maidens with too little; guitars softly strumming the plaintive minors of a primitive people; the hypnotic beat of a Senegambian tom-tom, summoning ebony damsels to quiver in the throes of a voodoo dance; shabby beach-combers and thirsty mariners; soldiers-of-fortune and the multihued warriors of colorful nations; and girls to lure the sailors from their duty—girls ranging in complexion from the sun at high noon, through the *café-au-lait* of Brazil and the Cape Verdes, to the blackest blue-black of Africa.

VICARIOUS ADVENTURERS

The Cleveland Museum of Natural History is a comparative infant in the circle of scientific institutions, for it was not organized until 1920, by Harold T. Clark, Lewis B. Williams, Alwin C. Ernst, and Dr. George W. Crile. Infused with the enthusiasm of a loyal group of sponsors and patrons, at the tender age of two and a half years it looked about for fields of endeavor beyond those of Ohio. At the suggestion of a friendly "elder brother"



Drawn by James M. Darley

THE ROUTE OF THE "BLOSSOM"

Embarking on the coast of New England in a three-masted schooner, smaller than the *Santa María* of Christopher Columbus, the author and fifteen other men of the Cleveland Museum's South Atlantic Expedition voyaged 20,000 miles by sail alone in a search for rare birds and queer beasts of land and sea. The *Blossom* visited the famed Sargasso Sea, prowled four and a half months among the islands of the Cape Verde Archipelago, and then sailed over to Senegambian Africa, where her men spent another four and a half months in the interior seeking Sudan birds and big game. South Trinidad, the little-known Martin Vas group, Rio de Janeiro, St. Helena, Ascension, Fernando Noronha, and Rocas Reef were then visited and studies in biology carried on.

among museums, it decided to investigate almost inaccessible islands and shores of the South Atlantic, of which but little was known.

In addition to specimens secured on the islands visited, the Cleveland Museum was to receive, for undertaking this difficult work and bringing study material to America, many rare birds from North and South America and the South Pacific islands from the collections of Dr. Leonard Sanford and the American Museum of Natural History.

Mrs. Dudley S. Blossom, trustee of the Cleveland Museum, made the voyage financially possible, and Captain George Comer, retired from the sea after half a century on sea-elephant ships, who had collected birds in the Antarctic and seen service with MacMillan in the Arctic, was sent along the New England coast to search for sailing ships.

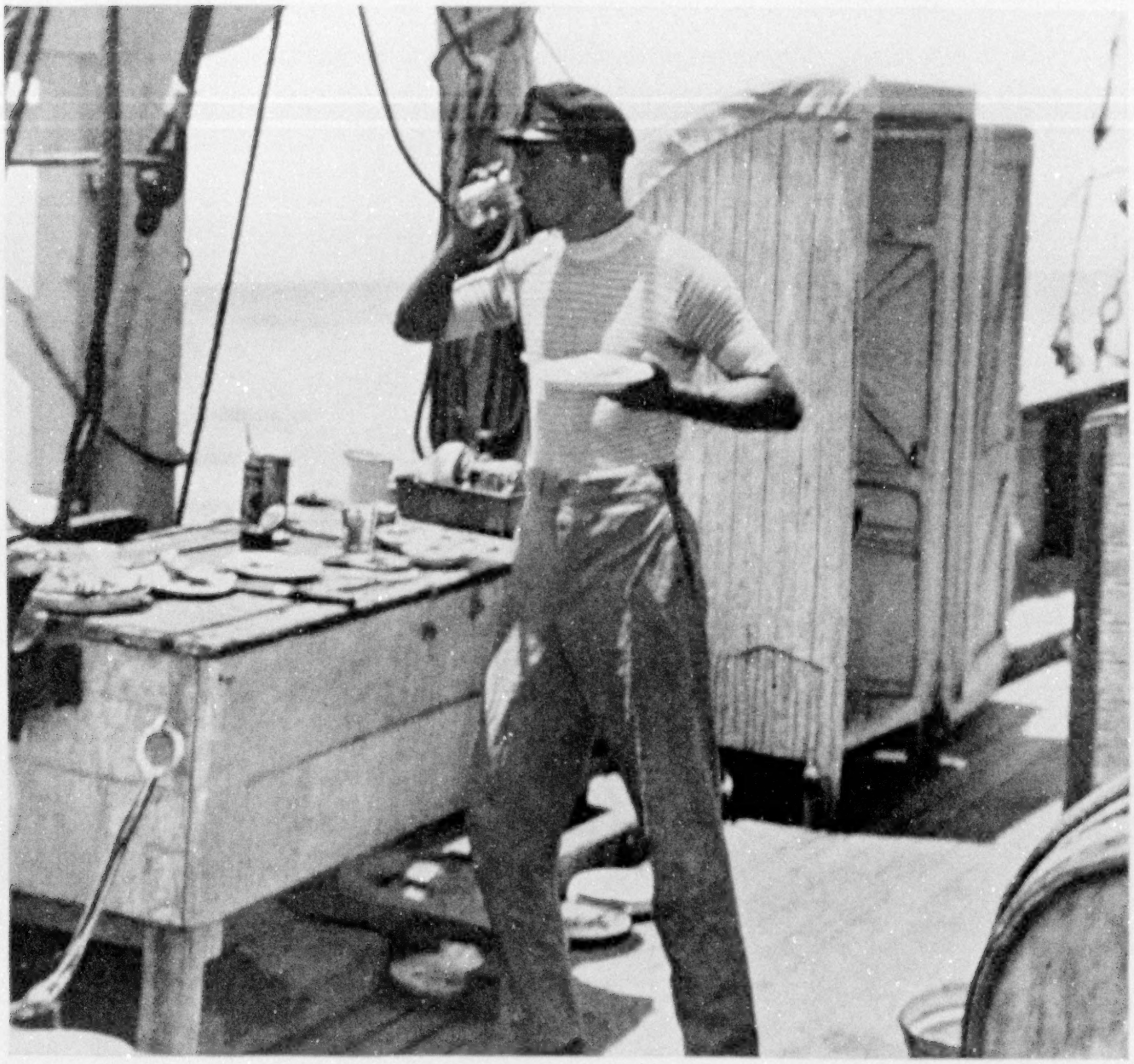
There was but small choice, and from the few available the *Lucy R.*, a Nova Scotia three-masted schooner built in 1920, was purchased for the voyage by the museum's director, Paul M. Rea, and placed for overhauling and refitting on the ways of a New London, Connecticut, shipyard.

Warehouses in the old whaling port

Photograph by Geo. Finlay Simmons

THE "BLOSSOM" CREEPS ALONG THE EDGE OF THE SARGASSO SEA

For centuries a large area in the Atlantic, filled with weird and shifting masses of gulf-weed (see map, page 5), was supposed to be the graveyard of the derelicts of the sea. In the course of its cruise of two and a half years the *Blossom* passed through this area twice and many days were spent in dipping, searching, and studying its peculiar fauna (see text, pages 13-14).



Photograph by J. Titta Vanzetti

A BUFFET LUNCHEON

Sticklers for etiquette might find fault with the author's interpretation of what the well-dressed man should wear for dinner on the rolling decks of the *Blossom*. Which fork should be used for the "salt horse"?

of New Bedford, Massachusetts, were searched for gear, whaleboats were chosen, and a selected lot of old whaling casks was set aside for water.

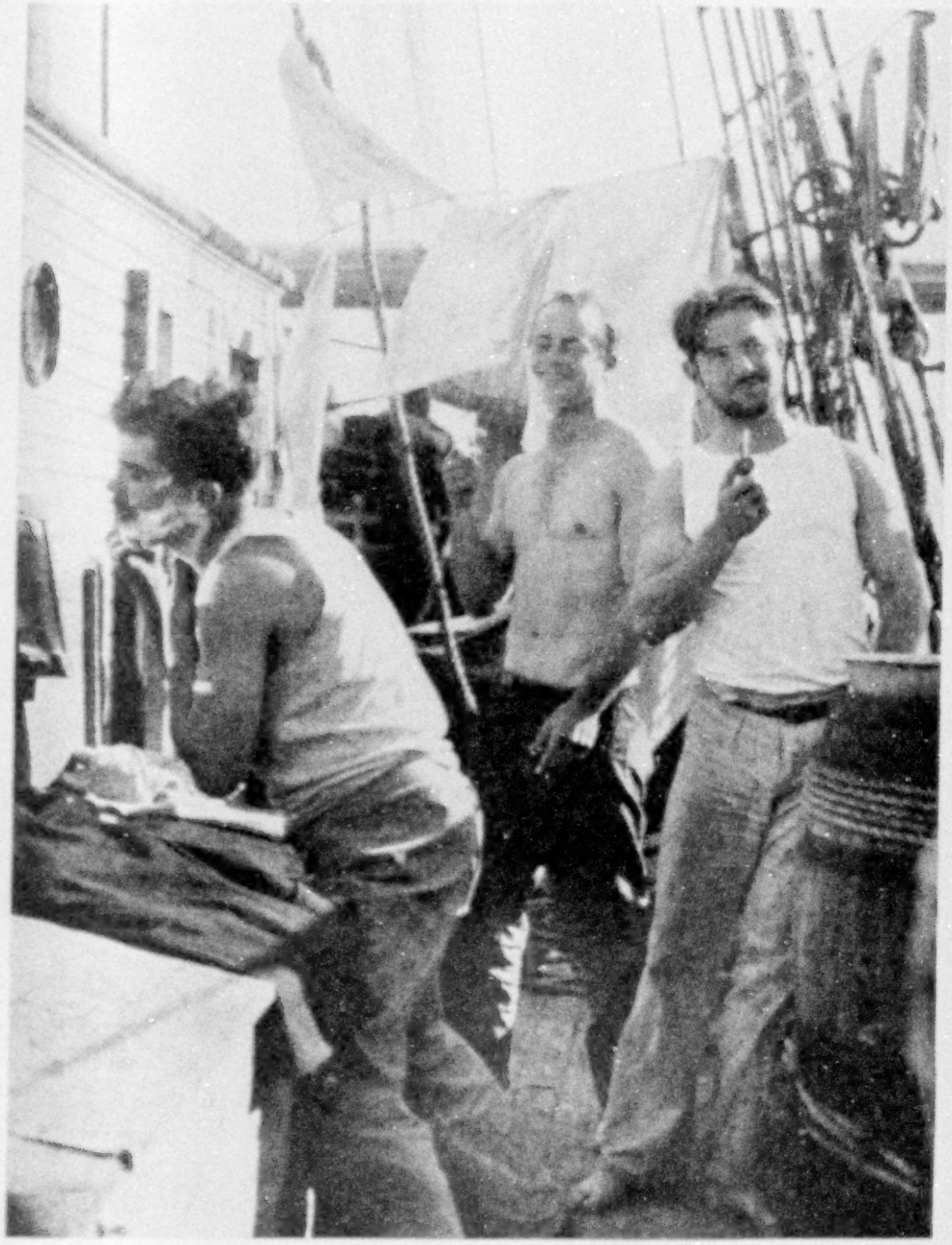
I came east from Texas to assume the leadership of the expedition and made the acquaintance of the little schooner just as she was ready to go on the ways.

SHOES AND SHIPS AND SAILING WAX

Almost complete reconstruction of the ship was necessary to make her ready for the long ocean voyage. Her decks were torn open, her hackmatack frame strengthened by the addition of many oak knees, her keel increased, her hull below the water line covered with heavy copper sheeting.

The whole appearance of the craft was changed by the addition of an enlarged cabin aft, with eight tiny cubbyholes of staterooms for officers and scientists, a deckhouse forward, a heavy windlass with new Samson post and bitts protected by the raised decking of a new forecastle head, side davits for the whaleboats and stern davits for the dory, and heavy ground tackle for holding the ship in difficult anchorages.

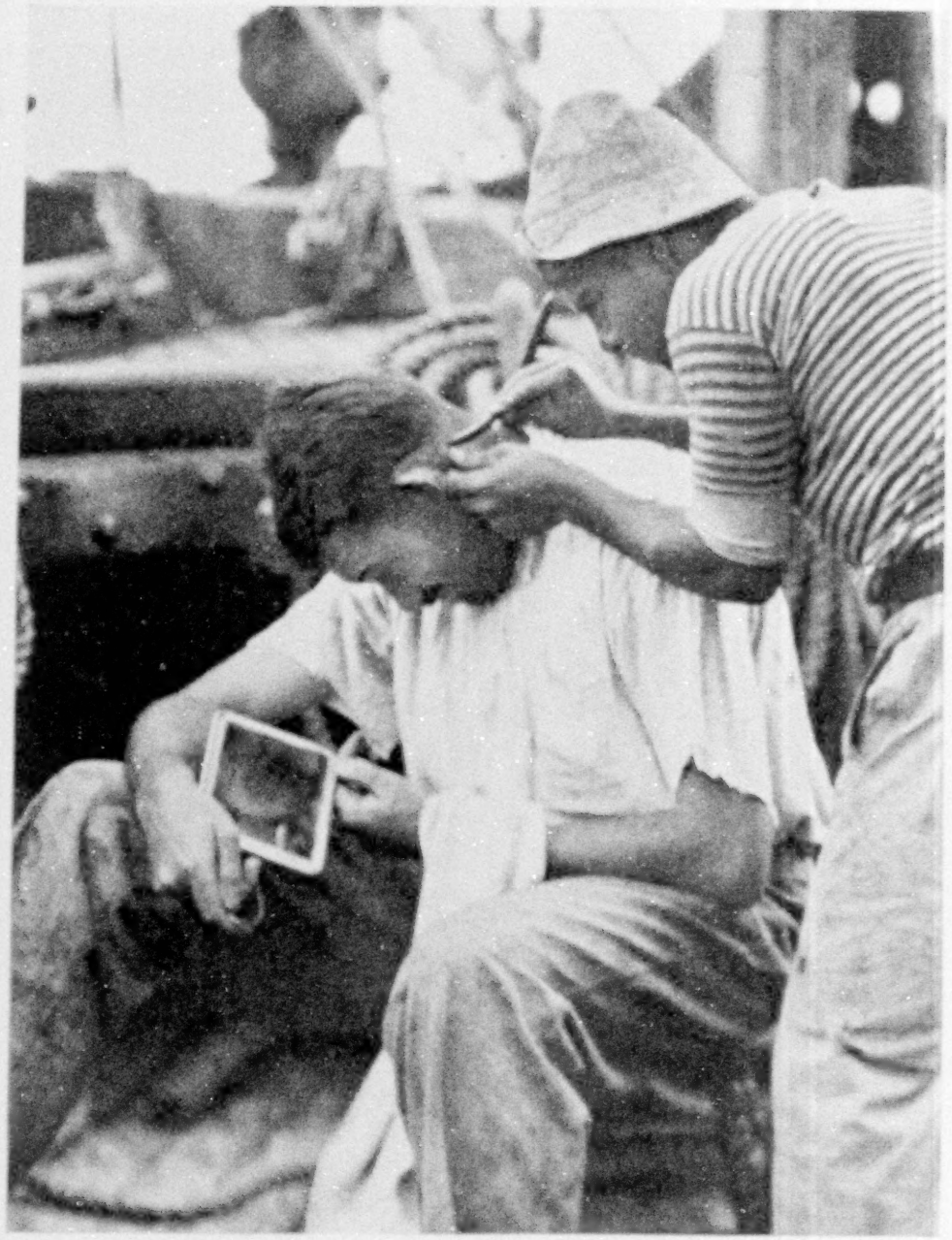
Fine wireless equipment was used only a few times during the early months of the expedition. Sea water went through everything aboard in bad weather, and men could not be spared from the decks to help recondition the set. Still less could men be spared later, when, with



Photograph by W. Kenneth Cuyler

PRIDE GOETH BEFORE A LANDFALL

Faces emerged from the foliage as the *Blossom* ran down the trades beyond the Sargasso Sea.



Photograph by Geo. Finlay Simmons

CUYLER TAKES A TRIMMING IN GOOD NATURE

The ship's barber shop was presided over by Cabin-boy Luis, who snipped and whittled at odd moments on the fore-deck.

Photograph by Robert H. Rockwell

THE PORT OF MISSING WHALEMEN

Furna, the tiny port of Brava, is hidden in a notch among gigantic hills that face the savage snarl of the free-blown trade winds. Here, back to their people in the Cape Verde Islands, went the "Portygee," one-time whalemen on American ships, once they had accumulated a small competence (see text, page 18).

Photograph by Geo. Finlay Simmons

THE BEAUTIFUL HORSESHOE HARBOR OF PORTO GRANDE

This, the capital of St. Vincent (São Vicente), is the most perfect port in the Cape Verde Archipelago. It is protected on three sides by mountains and has its entrance partly shut by the massive island of St. Anthony (Santo Antão), rising in the hazy distance (see illustration on opposite page).

the crew ill from exposure and tropical fevers, the specialists worked with sails and sailors helped skin birds.

Needles and pins, shoes and sou'westers, books and beans and shotgun shells—bewildering were the kinds of supplies needed to make the ship a self-sustaining world.

The lower part of the hold was pretty well filled with the old whaling casks, lying on their sides and containing the major part of the water supply. On top of these were stowed barrels, boxes, and crates of food; bales of excelsior and sacks of cotton for the taxidermists; and many cases of medical supplies presented by the United States Navy.

DOWN TO THE SEA IN SHIPS

We cast off shore lines as a depressing drizzle enveloped the Connecticut coast. Despite the rain, throngs of people covered New London's water front and cheered us, as a tug towed us down the Thames to Gardiners Bay, where Captain Kidd had anchored many decades before (see page 2).

We lay at anchor for several days, getting things shipshape and making ready for sea. Decks were high with equipment overflowing the hold—so high that the men, as they worked, could scarcely see the surrounding hills and shores tinted red with the foliage of fall.

Finally, with all repaired equipment and added stores back in place aboard, at noon of Saturday, November 10, 1923, we weighed and catted our anchors in the bows of the little schooner, slowly came about on an unrippled sea, and moved gently eastward on a southeast breeze.

During the afternoon we passed Plum, Gardiners, and Gull Islands; but, after dark, when the tides were setting strong against us, we made a long tack toward Long Island, lying south of us, came about, and made it past Block Island and Montauk Point, and slid comfortably out on to the gentle, open sea.

A tiny, black-hulled schooner . . .

Photograph by Geo. Finlay Simmons

COALING STATION OF THE WORLD'S TRAMP STEAMERS

Vessels lie in the Porto Grande harbor to take on fuel from the four big stations along the shore. The three masts of the tiny *Blossom* show on the near side of the tramps, beyond the coaling piers, while nearer at hand, on the left, are the inter-island fishing smacks and schooners. This illustration and that on the preceding page form a panoramic view of the harbor.

sixteen hands, all told, . . . perhaps sixteen men for some dead man's chest of a treasure islet . . . turning back the hands of time, watching America disappear into the night, gone from the map . . . a ship one-third the size of the *Santa María* and much smaller in capacity than even the *Mayflower*.

LIFE ON THE ROLLING DEEP

We left the coast of the United States in fine spirits, as our ship, rechristened the *Blossom*, cut quickly across the cold Labrador Current, left the tide rip and its petrels and shearwaters behind, and entered the warm waters of the Gulf Stream. A beautiful day or two, and then it looked as if we should never make it across to the African islands. It seemed as if we were out in the wintry Atlantic to stay.

We were subjected to every form of bad weather and unfavorable wind; it was a life in dripping oilskins, up at all hours to change tackle and come about with a changing wind. Bunks were soggy and food was scanty and ill-cooked. Weather was too bad to permit us to open the hatch for stores, and William's pots and pans leaped to the deck every few moments. No wonder our college-boy sailors soon had enough of adventure and swore they'd walk ashore at the first port, if they lived long enough!

We crossed the stormy North Atlantic at a time when the daily newspapers frequently carried news that steamships had been smashed to pieces at sea and foundered. A big steamer fights the sea, bucks the great rolling masses of blue water, and comes off bested. But the little sailing ship does not try conclusions with the waves; when properly handled, she heaves to in bad weather and rides the storm like a Mother Carey's chicken.

IN NORTH ATLANTIC STORMS

After nightfall on November 16 a storm tore down from the starboard quarter and caught the little ship under full spread of canvas. The man at the wheel blanched, as the ship heeled before

Photograph by Geo. Finlay Simmons

BUNGALOWS ON HIGH IN PORTO GRANDE

Small houses, with thick walls of volcanic stone and roofs fashioned from flattened gasoline cans, are half buried in the cinder slopes overlooking St. Vincent's harbor (see pages 10-11). Thus does the dweller on this desert island escape the full blast of the tropical heat.

the blast of wind-driven rain; he lost his head for a moment and put the wheel hard down. The *Blossom* lay broadside to the gale and the tremendous piling seas. Her lee rail was below the water, and the seas poured over her high weather rail as if over the proverbial half-tide rocks. The ship heeled so far that it seemed for a moment as if she must capsize. Then, wheel over, and away. . . .

Navigator Chantre clung to the tilting, sloughing deck and brought the wheel back, inch by inch, until she was hard down; and the *Blossom* came slowly about to face the gale.

Cuyler, worth three men in a pinch, took Moses forward with him, and the two of them began taking in headsails. A great sea swept over the starboard bow, poured over them, and beat them about, as they clung to the foreshrouds. Tons on tons of water poured down the forecastle companionway, which had been left open in spite of warning.

The boys did not have to be called a second time. They boiled on deck like drowning rats out of a hole and set about to help take in the topsails. For fifteen minutes it was touch and go, whether we should lose our masts or capsize before we could take in the heavy canvas; but the wind hauled a bit, we headed into

Photograph by Geo. Finlay Simmons

PIPE SMOKING IS BECOMING FASHIONABLE AMONG THE CAPE VERDE ISLANDS WOMEN

These sturdy women porters of Porto Grande carry and balance on their heads all loads except their children, who usually ride astride one hip (see text, page 18).

the gale, took in most of the sails, and then raced away before the storm.

For days we beat under darkened, angry skies and were buffeted by gale after gale, with the wind howling at 80 miles and huge seas piling up behind and rolling down on us. The ship climbed each mountain of water swiftly and hung precariously for a moment between sea and sky before dropping away into a great yawning valley.

At times the *Blossom* tossed like an eggshell; seas shook and poured over her in cascades. Water ran through the rudder well, worked into the cabin and hull, oozed into bunks, and soaked our clothing.

THE FRINGE OF ATLANTIS

We spread just enough canvas for steerageway, and both pumps were manned two hours out of every four. Still the water worked up in the hold, and the heavy stench from the bilges filled the cabin, where air became so unbearable with portholes closed that we stayed on deck, crawling under piles of sails to sleep fitfully.

It is in mid-Atlantic that Atlantis, mythical continent of the sages, is believed by many to lie submerged. Man has not yet plumbed these depths in search for Plato's lost cities. Perhaps Atlantis does lie here, under pressure of the middle deep, with the great current of the Gulf Stream circling about it. We cannot tell, but we are just as much interested in the large, still area of *Sargassum* weed which lies above it.

There had been adventure and romance here. Columbus entered the Sargasso Sea and must have been as perturbed as his crew when he sighted the weird and shifting masses of gulfweed which blanket the ocean in great patches of many acres, stretching beyond the horizon. For centuries this large area was believed to hold, in the center of its great tangle, all the derelicts of the sea, a graveyard of hopes outward bound, a "city of lost ships"!

Photograph by Geo. Finlay Simmons

A DAUGHTER OF THE DANCE

The throbbing of drums on Santiago Island urges supple maidens to undulate their grassy skirts and keep the older people singing the high-pitched "morna" and treading a serpentine dance.

We eyed those fields from the quarter-deck of the *Blossom* on a fair day. Under a blazing sun we dipped rough masses of brown seaweed on to the decks, where it was pawed over for specimens. Hollow floats, or air bladders, hold the small patches of weed close to the surface. It has neither long tentacles nor strong ones with which to entangle passing ships.

More than two years later we found, when we entered the corner of the Sargasso Sea in its southwestern area, between eastern Cuba and Bermuda, much thicker areas of the weed, as if it had drifted gradually southwestward before northeast winds, currents, and squalls, which have scattered and spread the main body of the dread sea.

Our days we spent dipping, searching, and studying the peculiar fauna of the area. Portuguese men-of-war occasionally floated in clear water between the masses of *Sargassum bacciferum*, sheltering between their stinging tentacles the queer little Portuguese man-of-war fish.*

*See "Interesting Citizens of the Gulf Stream," by John T. Nichols, in the NATIONAL GEOGRAPHIC MAGAZINE for January, 1921.

Under the weed itself we found tiny infants of the ocean giants: the sailfish, jackfish, bonitos, and sunfish; and more than a score of species which would never grow larger than a few inches, especially the coral-tailed filefish, trigger-fishes, the burr-fish, the pipefish, and two kinds of porcupine fishes.

Most abundant of all, however, and more abundant even than the blue-dragon slugs and the peculiar crabs of the weed, were the little frogfish cannibals with their enormous maws. Several of these were put in a salt-water basin with highly prized specimens, which included a rare little butterfly fish. A moment later the other fishes were gone, and the swollen stomachs of the cannibals told the story. We quickly cut them open, and out swam the little Jonahs, uninjured!

WE GET THE NORTHEAST TRADES

We could easily understand why the Sargasso Sea is shot with wild tales of windjammer days, for we were held in the weed for more than a week—held not by the weed itself, but by the lack of wind or current to take us elsewhere.

Photograph by Geo. Finlay Simmons

A POSSIBLE FUTURE WINTER RESORT FOR AMERICAN VISITORS

Well-paved streets, neat and pastel-tinted houses, and the whitest Cape Verdean islanders are found in the chief village of Brava, on the southern edge of Atlantis.

Then squalls treaded along the north edge of the Sargasso Sea and soon we were moved out of its influence.

Head winds from the east kept the ship beating northeast and southeast in long tacks, a windjammer indeed, making but little progress. But when the northeast trades picked up, once more we sailed, down to the beautiful archipelago of the Cape Verde Islands. The sea became populated with steamers and birds; porpoises played about the ship and were harpooned for our museum collections.

The men were hanging from the rigging as we came to anchor in the port of São Vicente after 40 days at sea—hanging by their hands and feet, as they cheered arrival at land, not triced by their thumbs, as in days of yore.

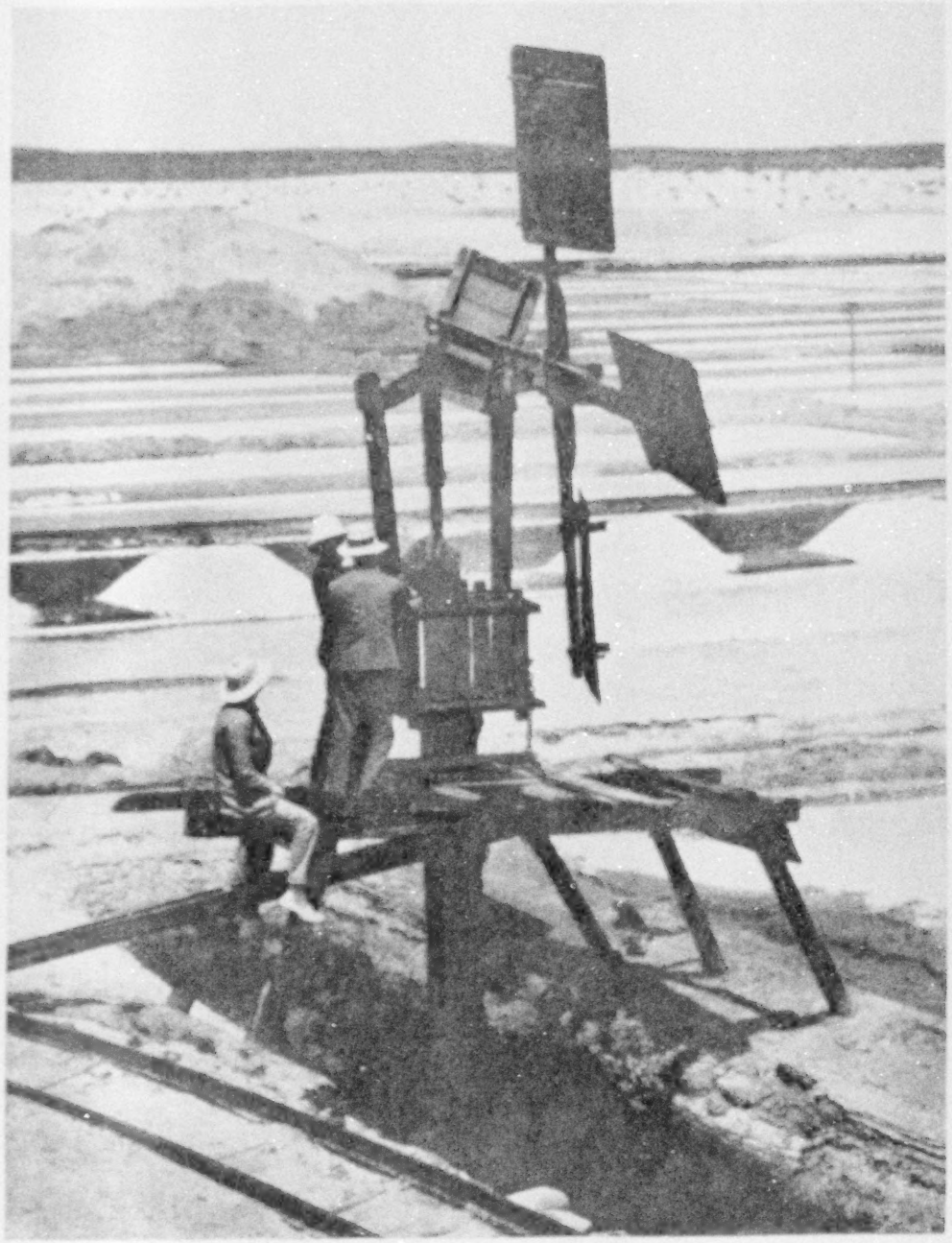
BLACKBIRDERS' ISLANDS

The Portuguese archipelago of the Cabo Verde, lying several hundred miles out in the Atlantic off the northwest shoulder of Africa, is especially interesting to the zoölogist, for here he finds a comparatively little-known Old World group corresponding in size and general position to that of the Galápagos,* mainly on a study of which New World archipelago Darwin based his theory of the origin of species by natural selection.

Especially interesting are the Cape Verdes when one learns that Darwin collected there a few specimens at the beginning of his famous voyage on the *Beagle*. Nearly a century after Darwin and long after the islands had been for decades a clearing house for slave traders, in the days before the Civil War in America and before Great Britain's battle fleet drove blackbirders from the sea, the collectors of the *Blossom* spent four and a half months gathering specimens about and over the nine larger islands, five islets of considerable size, and many off-lying rocks.

There are fishes in abundance about all the islands, and these were sought for in spare moments; but the principal work of the collectors was the search for birds.

* See, also, pages 19-30, "The Dream Ship," by Ralph Stock, in the NATIONAL GEOGRAPHIC MAGAZINE for January, 1921.



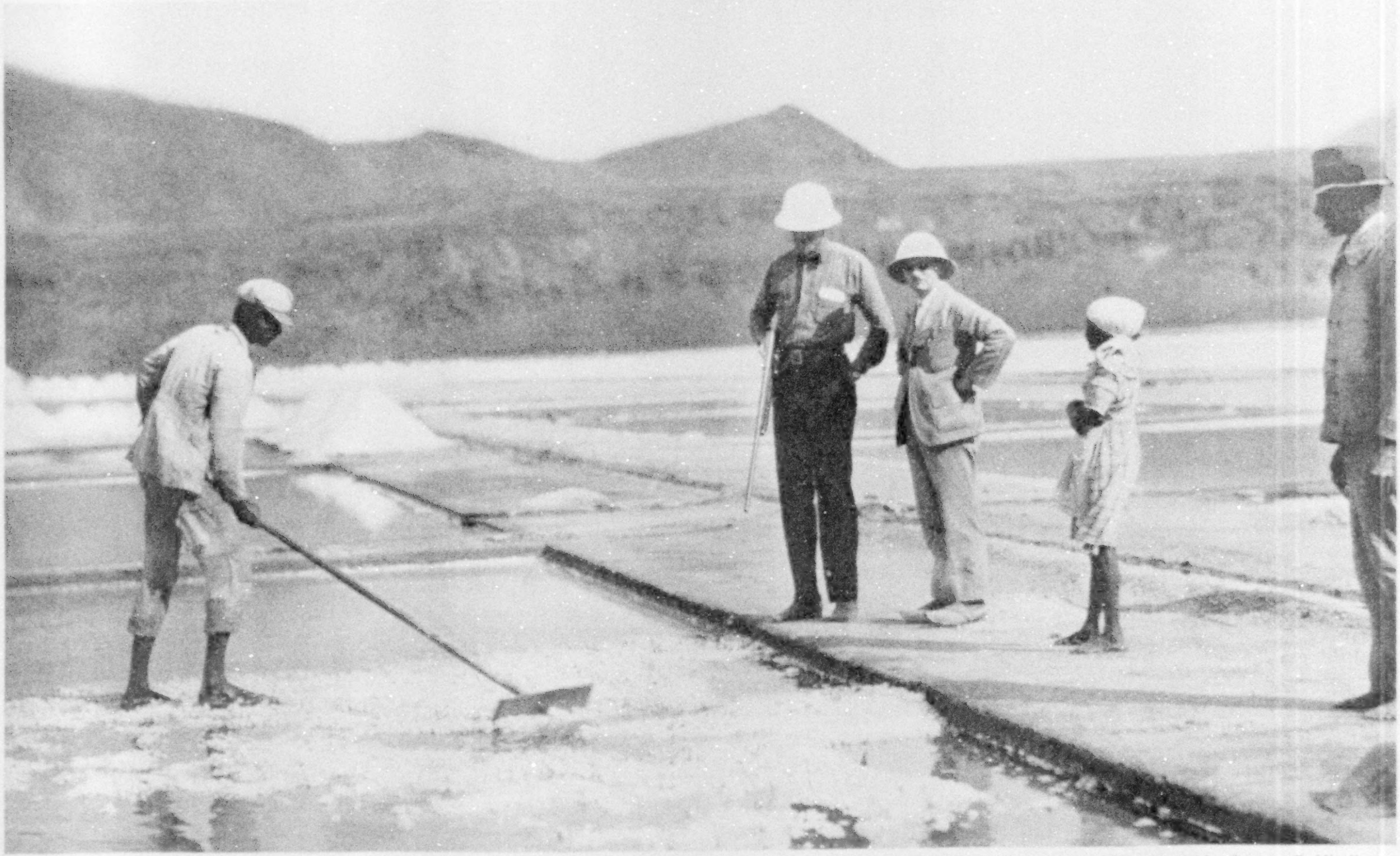
Photographs by Geo. Finlay Simmons

DON QUIXOTE'S ANTAGONIST STANDS GUARD OVER AN ISLAND OF SALT

The desert surface of Ilha do Sal (Island of Salt), in the Cape Verde Archipelago, is given over to the manufacture of salt by evaporation of sea water under the powerful rays of the sun. Little labor is necessary, since windmills pump the water into the irrigation ditches (see page 17).

THIS WEIRD BIRD COMMEMORATES A DARING DEED BY NOTED AIRMEN

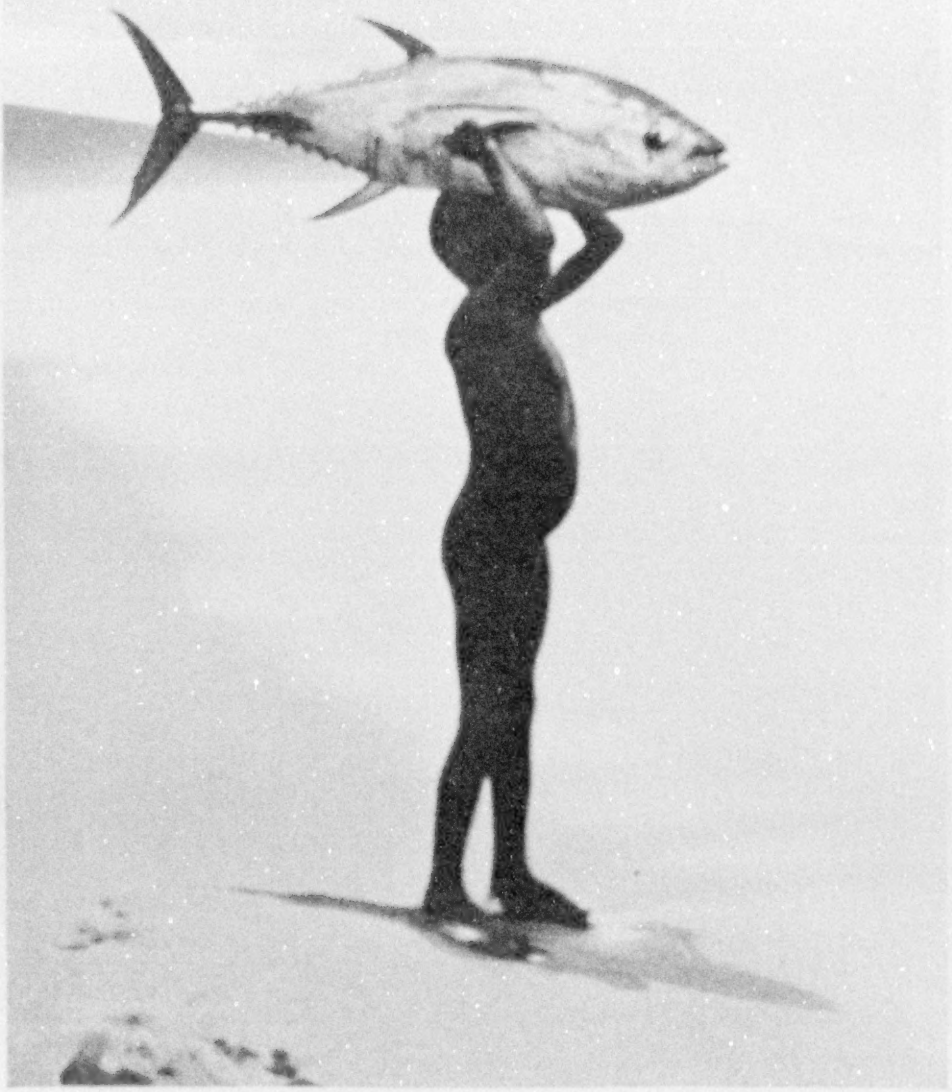
As a memorial to the landing of Portuguese pioneer aviators, Admiral Coutinho and Captain Sacadura-Cabral, flying from Europe to South America, this fourth attempt at a statue on the St. Vincent water front still fails to meet the demands for an eagle poised.



Photograph by Georges P. Virolle

ICE-CREAM SALT MADE BY THE SUN

French Manager Barbe (wearing sabots) shows the author how the Cape Verdean natives loosen up the salt following evaporation under the fiery rays of the tropical sun (see, also, page 16). European shore-birds winter among the salt pans, in which a strange little shrimp makes its home.



Photograph by Robert H. Rockwell

TUNAS FOR TUMMIES

Offshore thoninhas, bonitos, and albacores are landed on the ebony beach of Fogo, in the Cape Verde Islands. Small boys carry the fish across several miles of volcanic stones and dust from port to village.

There were adequate landings at only four towns in the archipelago, but hundreds of other landings had to be made on steep volcanic shores of the islands or through roaring breakers onto beaches of ebony and sand. Many of these islands are desert, some rugged, some flat; but there is little vegetation on them and scarcely any water.

The men of the islands do little manual work, while women are the beasts of burden. Cuyler, Moses, and our other collectors, with their food and camping equipment carried by sturdy women porters, ranged for miles and miles over mountainous islands in search of rare desert larks, coursers, waxbills, kingfishers, swifts, hawks, and other birds.

Some of the islands rise far above the clouds. There were difficult mountains to climb on Santo Antão, São Nicolao, and Brava; and Fogo, the island of fire, with its smoldering volcano, rose higher still, towering to nearly 10,000 feet (see, also, text, page 19).

Most of these islands stand in the open sea, as monstrous monuments to the feverish action of long-dead volcanoes; some of them have become cloaked with vegetation.

A TRAGEDY NARROWLY AVERTED

Thrills were frequent while we were collecting. On one occasion we had landed with great difficulty on the bare offshore rock of Corral Velho to spend the night with Cape Verde and Boyd Alexander shearwaters, the brown booby, the white-faced and Madeiran petrels, and other queer birds of the sea. Some distance away the *Blossom* stood off and on, under trimmed sail in the face of the trades, which piled high seas against our little rock.

Seas had risen by the following afternoon, when a ship's boat came to take us off. The men at the oars drew near, took one look at the face of the rock, and wanted to turn back to await a better day.

We on the rock were without food and water, so we ordered them in close. Then we stripped to the skin and threw our belongings from the top of a cliff, to be caught or missed by the men in the boat.

While trying to get Moses, who had never learned to swim, out on a promontory where the boat could pick him off, a great sea swept me into a whirlpool. For a moment my companions thought I was lost; but, bruised and shaken, I managed to crawl back on the islet, and we tried it again with better success.

Cuyler and his collectors went in search of the rare ghost petrel (*Pterodroma mollis feæ*), of which but few individuals had ever been taken. Specimens spoil quickly among the volcanic mountains of these tropical islands, so that a great deal of equipment must be carried even on a short field trip. The party, which included a number of women porters, wound along the old trails of the island of São Nicolao, crossed deep valleys, and climbed for thousands of feet up the faces of steep mountains.

Photograph by Geo. Finlay Simmons

A SHY LITTLE MAID OF MAIO

The blood of slaves darkens classic features inherited from early Portuguese explorers in the Cape Verde group.

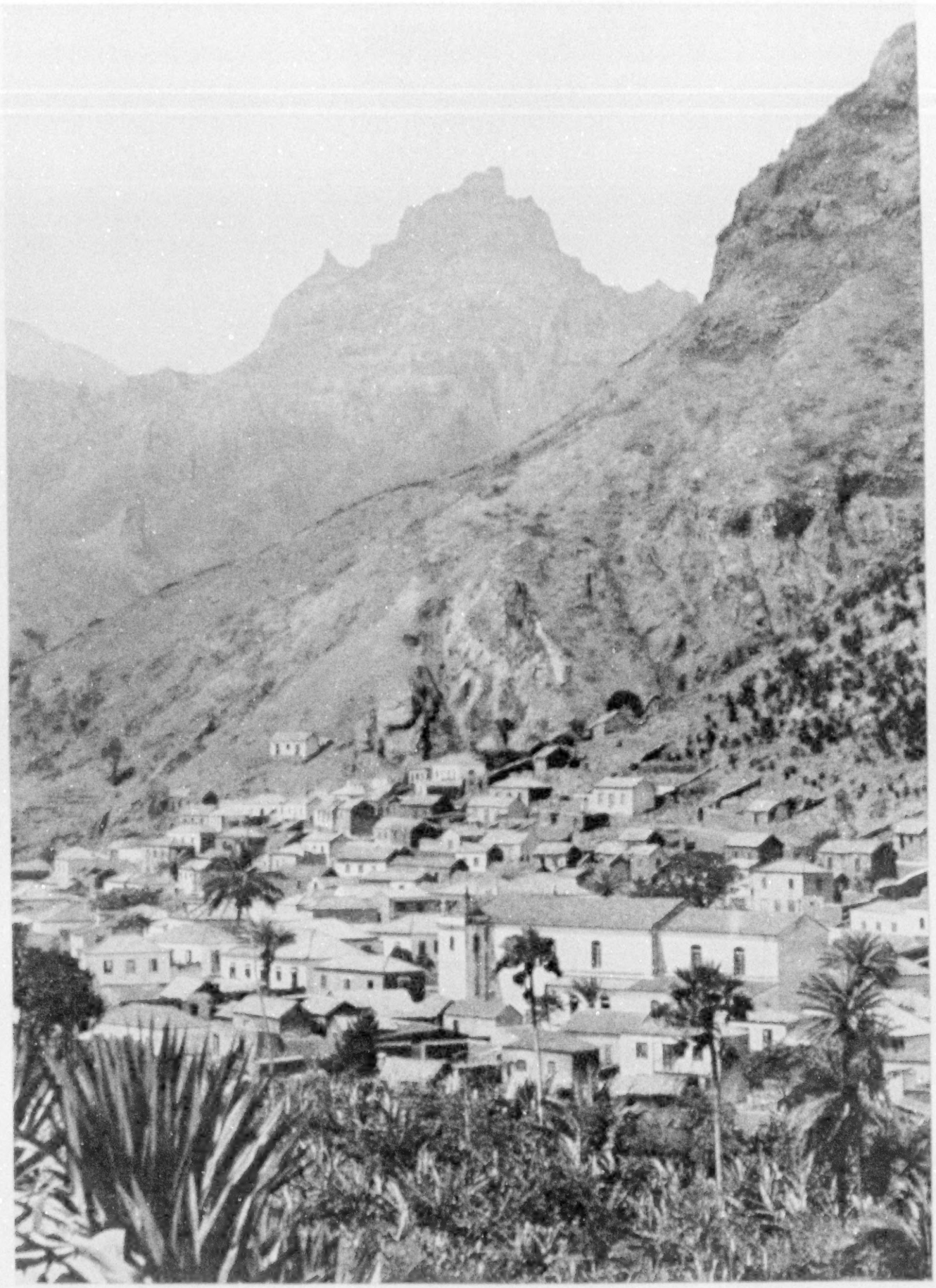
The husky porters, used to such work, fell in their tracks from exhaustion; but Cuyler piled an additional load on top of his head and pushed on. Tons of rubble rock were moved by hand on the slopes where the rare birds lived, and the collectors returned with more than a dozen of them.

JAIL IS RAIDED TO OBTAIN PORTERS

Three of us circled the island of Fogo and climbed to the top of its volcano. Porters for this trip could not be hired, so the governor of the island ordered the prisoners out of the jail, and they carried our extra equipment on a hurried four-day tramp. The peak of the smoldering volcano stood so far above the clouds that they seemed spread out in a map below us, and so steep were the sides that, looking down almost vertically, we could see the shore of the island 10,000 feet below.

We returned through the fertile part of Fogo, facing the trade winds, where the moisture of the clouds produces luxuriant growth, and filed with the governor of the island "Maçedo" as a name for this smoking monster mountain, Maçedo being the leading family of the place, descended from an early explorer.

After collecting many hundreds of birds, some of which were new and many of which had not been taken since the



Photograph by Geo. Finlay Simmons

THE MOUNTAIN HOME OF THE GHOST: CAPE VERDE ISLANDS

Thousands of feet above the sea, overlooking the little town of Ribeira Brava, on St. Nicholas (São Nicolao), Cuyler and his men collected old birds and young of the gongon, or ghost, one of the rarest mountain petrels known to science.

Photograph by Geo. Finlay Simmons

PORTUGUESE ROADS TWO CENTURIES OLD

Several fine stretches of highway are to be found on the island of St. Nicholas, usually cobbled with hard basalt stones. In this desolate district the collectors sought rare species of kestrel, desert lark, waxbill, and warbler.

days of Darwin, and having increased the island list from 75 to well over 100 species, we headed for Africa.

ON TO "THE PARIS OF WEST AFRICA"

The *Blossom* had been badly strained in the rough passage of the North Atlantic. Vital repairs had been made by a small shipyard at São Vicente, but other repairs and considerable recalking were necessary. These we planned to have done in Dakar, the capital of French West Africa, which had been described to us as the Paris of West Africa, the finest city between Europe and Cape Town.

We anchored in Dakar Harbor, and went ashore to see this city about which we had heard so much.

Dakar might be called the peanut capital of the world, for the surrounding region is gradually being cultivated with that humble legume. During the harvesting season great loose mountains of them are piled on the quays of the port, and a constant string of steamships departs for Europe loaded to the hatches with peanuts. It is not surprising, therefore, that along trails in the interior we frequently saw families of green monkeys and the red, and bands of hundreds of dog-faced monkeys, with occasional individuals of rarer species.

Dakar lies on the middle coast of Senegambia, where the Great Desert meets the African bush country. Here is the westernmost point of the continent, the land of the blackest negroes wearing the whitest robes and speaking the strangest tongues that a white man can imagine. Here are Mohammedans, with their prayer rugs, throbbing tom-toms and sensuous dances, and thatched huts among the forests of giant baobab. Here is the setting for a thousand dramas of history and natural history.

Along the shores we found strange pelicans, gulls, terns, and cormorants; and in the marshes, for we were there

Photograph by W. Kenneth Cuyler

BEARING THE WHITE MAN'S BURDEN ACROSS DESERT SANDS

Donkeys are rare and strong women are numerous; so two of the regular dusky Amazonian porters of the Cape Verde Archipelago accompanied a bird collector of the *Blossom* and his native guide across St. Vincent (see, also, illustration, page 13).

Photograph by Geo. Finlay Simmons

OUT FOR A LARK (AMMOMANES) ON A DESERT ISLE

Nearly a century ago Charles Darwin collected rare and strange larks and other birds in the Cape Verde Islands. These are well represented in the *Blossom* collections.

Photograph by Geo. Finlay Simmons

THE PERILOUS ISLET OF CORRAL VELHO

Brown boobies make their home on the top of this tiny sandstone islet, where several members of the expedition almost lost their lives, near Boa Vista, in the Cape Verde Islands (see text, page 18)

during the rainy season, we found queer little grebes, long-toed jacanas, herons and egrets. Vultures and hawks loitered about the native slaughter pens.

In the bush there were hornbills, weaver birds of many sorts, the bateleur eagle, warblers, titmice, doves, sparrows of many kinds, red-breasted shrikes, parrots, hoopoes, owls and nightjars, and queer kingfishers, from the size of one's thumb to the size of one's shoe.

A lowland interior swamp, the Tamna, sheltered tree-ducks, rails, lapwings, coursers, and shore birds of various species. We obtained specimens of the African painted snipe, various species of rollers, cuckoos of many colors, woodpeckers, and brilliantly glittering African sunbirds.

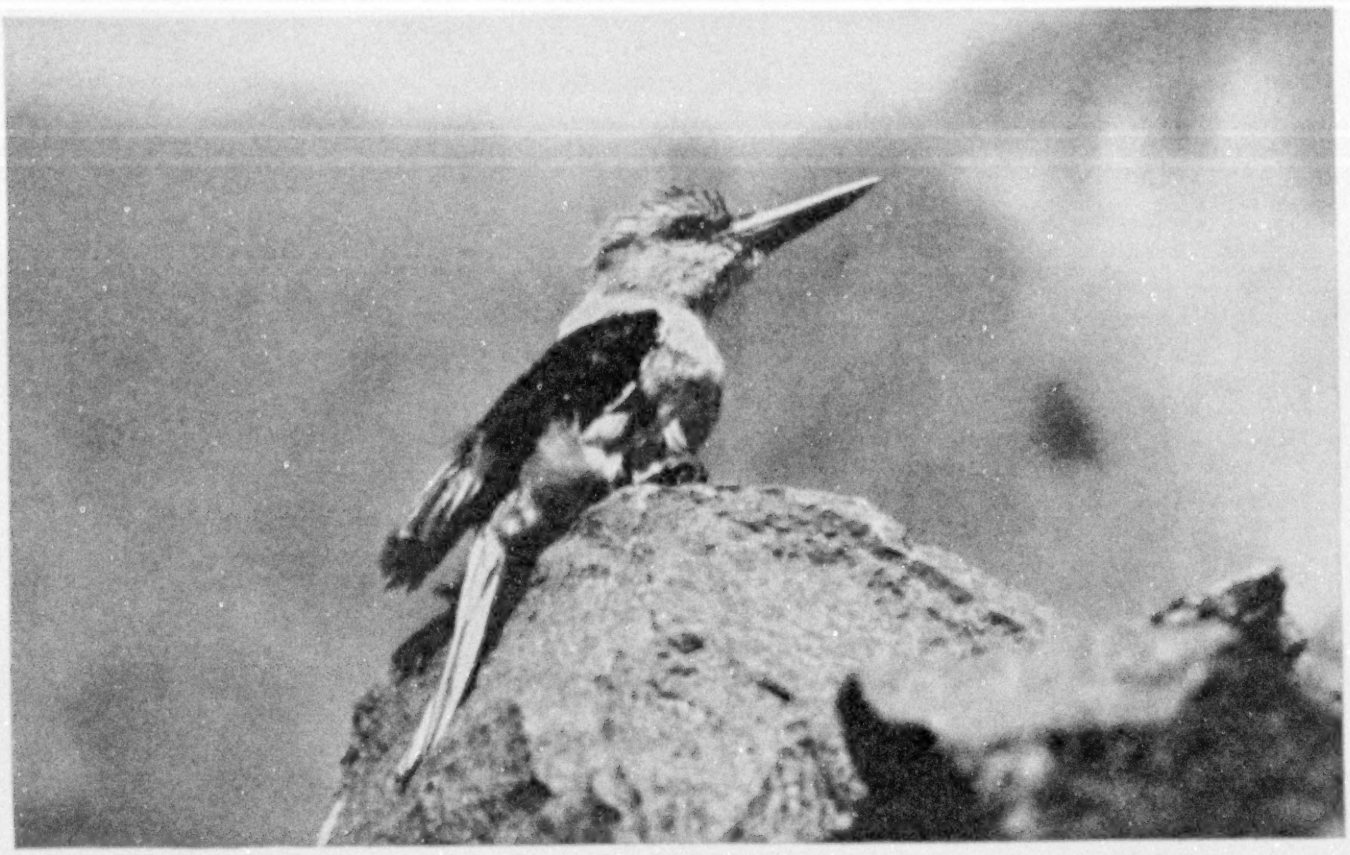
A SHEIK OF SENEGAMBIA

I made a trip into the interior, where several of our men were collecting birds at Thiès, a village of about 13,000 natives and a few French officials and merchants. The chief of the place arranged native Ouolof and Mauretanian dances for us and gave me much information about native customs (see page 33).

"Yes, we are Mohammedans," he said in his best French, "but only the middle classes have more than one wife. The poor man can support only one, and the upper-class men know that a man can get along with only one woman at a time, but the middle-class men marry several times. If a man has more than one wife, he must have four. Two wives fight; if there be three, two fight the third; and four is the smallest number a man can have and maintain peace in the family!"

"How do you choose your wives, and can you get divorces?" I asked

"A young man talks to the father of the girl of his choice and pays him a sort of dowry, which consoles the family for the loss of the girl," answered this grizzled old sheik. "An ordinary wife is valued at the equivalent of twelve dollars; but a wife who can read, write, sing and dance, cook, and who has nice clothes, is worth sixty dollars. If a man and his wife want a divorce, they go before the commis-



Photograph by F. Herbert Fowler

A SOLEMN NEPHEW OF THE LAUGHING JACKASS

Darwin's kingfisher, one of the rarest birds in the world, "hangs himself on a hickory limb" and spends his days on the desert isles of the Cape Verde group in pursuit of the wily grasshopper.

sioner and he grants it; the husband pays the wife an amount equal to that her father received and she goes back to her people."

SENEGAMBIAN BIG GAME

Cuyler and Robert H. Rockwell, who went back into the interior to hunt big game in the Bondu country, found conditions somewhat different. They traveled inland with equipment and an interpreter-cook, Sorie Bah; secured a famous old hunter and his assistants as guides, with a couple of Senegalese soldiers to guard their equipment, and started for the banks of the Senegal and Gambia rivers, where camp was established (see page 33).

Some of the native Mandingo chiefs and subchiefs here ran to six or seven wives and lived in considerable style in their thatched-roof houses. One chief, a graduate of a French college, had a modern flat-topped desk in his office, with a stenographer, who used the typewriter very efficiently, to handle the French correspondence which piled up regularly on the desk.

Even though the game was scattered by the rains, the two hunters bagged some interesting specimens of the hartebeest, roan antelope, water-buck, bush-buck, harnessed antelope, Ward's and the bohor reedbucks, several kinds of the little duiker antelopes, wart-hogs, and other African mammals.

Especially fortunate were they late one afternoon in hearing the coughing roar of a big male Gambian lion *(Felis leo gambianus)*, which broke from the bush ahead of them up an open trail. Cuyler gave Rockwell, the more experienced hunter, the shot. The first two attempts, with sights at 300 yards, stirred the dust beyond the lion; the third, with sights slightly lowered and gun resting over Cuyler's powerful shoulders, struck the lion in his left eye, shattered his mastoid, and dropped him in his tracks, at a measured distance of 273 yards—a feat that, when related, impels the listener to tell the story of the lion tamer and the lyin' scoundrel!

WE LEAVE AFRICA BEHIND

But we have the lion skin—that's what we needed—and it is, we believe, the first of its kind ever brought back to America.

Photograph by Geo. Finlay Simmons

THE ELUSIVE MOTHER CAREY'S CHICKEN

Astern of the *Blossom*, this stormy petrel (little Peter) hopped along and walked on the water as successfully as did St. Peter in New Testament days. For centuries mariners believed that the bird never approached land, and argued that it laid its egg at sea and carried it about under one wing until it hatched (see, also, illustration, page 26).

We were sorry to leave the Senegambians at the end of our four and a half months in their territory, but we had interesting islands ahead. Our shipyard work had been slowly completed in Dakar, we had reconditioned the equipment and laid in new stores, and had discharged and sent home our first crew of turbulent college boys. They wrote to their home papers that they had left us "flat" and stranded in Africa.

DOWN THE ATLANTIC

Our first sailing master, Emery H. Gray, was put in a hospital at Dakar. In his place Capt. John Titta Vanzetti, formerly an officer in the Italian Navy, joined us as executive officer and navigator, and drove staunchly through with us for more than two years, industrious, friendly, companionable, to the end of the voyage.

Director Rea, of the Cleveland Museum, had come across by steamer from Newport News to discuss our problems with us and take back to the States our many packing cases and barrels of specimens. He left the harbor on the giant collier *Kina* just as we pushed out from Dakar, late one afternoon.

Three days and a fraction it had taken us to make the run from the Cape Verdes across to Africa, but from Africa back to São Vicente it took us a dozen, as we rocked and wallowed with light winds in the Guinea Current. We added three Caboverdeans to our crew and spent several weeks collecting on Santo Antão and São Vicente Islands and on the islets of the Rombos group.

Down the Atlantic we went in November, eager to land on islands where rare species of boobies, tropic-birds, terns, and men-of-war were to be found.

DISCOMFORTS IN THE DOLDRUMS

We were congratulating ourselves on the wonders of life under sail, when the northeast trades died out entirely and left us to be pitched and tossed about by the many counterseas of the doldrums—

Photograph by Robert H. Rockwell

MINING FOR MOTHER CAREY'S CHICKENS ON CIMA

Simmons and Cuyler found this small petrel not carrying its single egg under its wing at sea (see illustration, page 25), but laying it under the soft soil of a sea-torn isle of the Cape Verde Archipelago.

that mid-Atlantic area, stretching from South America across to Africa, muchly cursed by sailormen (see map, page 5).

Here the warm air moves upward toward the fleecy clouds. Neither the northeast trades nor the southeast trades reach into this belt, and a sailing ship must depend on the occasional squalls which darken the clouds and beat down for a few moments, then pass on. Each of these pushes the ship a few miles, after which she rolls and pitches once more, and the weary mariner clings, sleepy-eyed, to the rigging and prays for wind.

OUT OF THE DOLDRUMS AND ACROSS THE LINE

By watching the direction from which the squalls came, we could usually trim the sails to catch the wind on the right tack, and we slowly circled for a week and eventually crept from the doldrums.

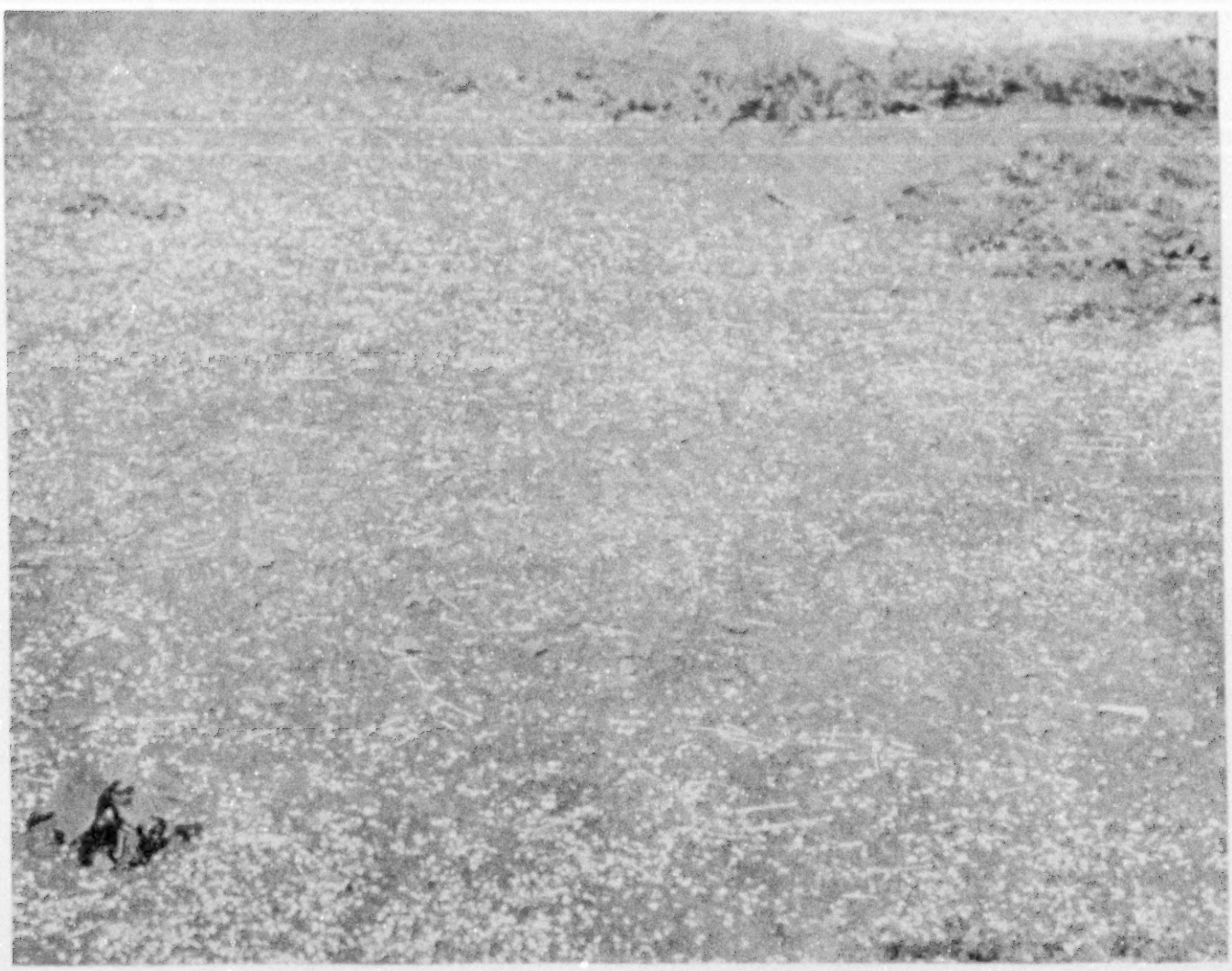
The southeast trades now reached us and we sailed southward; but we were swinging so far to the west that we failed to make St. Paul Rocks, a group of islets inhabited by a few sea birds. We came about and beat back on a long tack which took us northeastward toward the edge of the doldrums. Around we came again, but the direction of the winds and the force of the equatorial current were too much for us. We were forced to give up the islets and once more strike southward.

We crossed the Line at a merry clip, with the southern heavens bright with constellations new to us.

We nursed the ship carefully along, jamming her into the wind as much as we dared; but it looked as if she would never get into the South Atlantic beyond the big eastern shoulder of Brazil.

WE FAIL TO MAKE FERNANDO NORONHA

We finally sighted the island of Fernando Noronha and slid a few miles past it on the leeward side. The wind, the rolling seas, and the equatorial current that raced for the West Indies were all against us, and we tried for several days



Photograph by Geo. Finlay Simmons

MOTHER CAREY'S GRAVEYARD ON THE SHIFTING SANDS OF CIMA

Unique and uninhabited, the Cape Verde Isle of Cima (see, also, illustration, page 26) is covered with the tiny bones of millions of petrels which in ages past have sought its tiny plateau when it came their time to die.

to beat up to the island and its anchorages. "Hard alee!" Time after time came the cry. It was useless, for we lost a little on each tack.

"We'll make the island from the east when homeward bound," was the final decision (see, also, text, page 59), and we set our course once more for the south. Day after day we logged 75 to 100 miles, and 13 days after leaving Fernando Noronha we sighted the Martin Vas group one morning in December just before daybreak.

AN ISLAND NAMED FOR MAURY, PATHFINDER OF THE SEAS

We made ready a whaleboat and sailed on down to spend half a day among the islets. As far as we have been able to tell from hydrographic and admiralty records, no one had ever chronicled a landing on any of these islands; so it was with a great deal of interest that we sailed along the shores through a placid sea.

We landed first on the north islet, which we christened Blossom. Small white-capped black noddies were nesting along its rugged faces, and low on the rocks on one side we found sooty terns also. The tide pools were filled with many brightly colored fish and invertebrates, and a few feet away, in four or five fathoms, the men in the anchored whaleboat were catching larger fish hand over hand.

The middle island we called Dom Pedro Segundo, after the last emperor of Brazil. It rises to a height of, perhaps, 600 feet, with steep and practically inaccessible sides. Two kinds of sedge grew pretty well over the top and down a few of the gentler slopes, and mountain petrels sailed and circled off the cliffs among the soaring men-of-war of two species, *Fregata ariel trinitatis* and *Fre-*

Photograph by Geo. Finlay Simmons

PREPARING SPECIMENS ON THE HIGH SEAS

Rockwell, Moses, and Cuyler grew accustomed to such delicate operations as the skinning of Mother Carey's chickens on the decks of a plunging, wind-blown lugger.

gata minor nicolli, which we later found nesting on South Trinidad.

We landed on the middle rock, placed a copper plate with an inscription in a conspicuous position, climbed more than half the way up the side, and then returned to the waiting whaleboat.

The southern islet we named Maury, after Matthew Fontaine Maury, American naval officer who first charted winds and currents of the ocean, and whose work in this field led to the establishment of our Hydrographic Office, Naval Observatory, and Weather Bureau. He was also the real father of the U. S. Naval Academy.* We circled close around it in a whaleboat and ascertained that it is possible on a calm day to land on the southeast side. Afterwards, laden with specimens, we proceeded northward to the waiting *Blossom*.

The following day we sailed westward toward South Trinidad, which stood on the horizon, 25 or 30 miles away. We circled around North Point and anchored on the lee side, in Waterfall Bay. The gigantic mountains of this volcanic island rear their lofty heads 2,000 feet above the sea. Phonolite and coral reefs surround the iron-bound coasts and make landing extremely difficult.

TREASURE ISLAND AT LAST

We spent a month at the island, circling it in the whaleboat and landing in half a dozen places. We crawled slowly over its ragged sides and searched for the nests of the Trinidad mountain petrel, the red-footed booby, the two species of man-of-war birds, the sooty tern and the noddy, and the delicate little fairy love-tern.

No other island of its size—less than four miles long and two miles wide—bears on its surface such interesting features. Discovered by the Portuguese and claimed by the English, it has been the subject of international litigation. Until

* See "The Gem of the Ocean, Our American Navy," by Josephus Daniels, in the NATIONAL GEOGRAPHIC MAGAZINE for April, 1918.

MERRYMAKERS AT A VILLAGE ON THE ISLE OF BOA VISTA

Garbed in their one best dress, Cape Verdeans walk barefooted for miles over a volcanic island to lessen the wear on the only pair of shoes they have ever possessed. Lovers of their morna music, they gave dances at nearly every little town for the footsore bird collectors.

Photographs by W. Kenneth Cuyler

THE CHEAPEST HOUSES IN THE WORLD

A Cape Verdean home can be built for little or nothing; volcanic stones from the front yard are erected without mortar into thick, substantial walls; a roof of thatch from a near-by valley is practically as good as imported shingles, and labor can be had at a few pennies a day.

Photograph by Geo. Finlay Simmons

LAND HO! THE "BLOSSOM" APPROACHING AFRICA

Cuyler, lured by the mystery enshrouding the Dark Continent, watches the shore line of Senegal slowly materialize in the eastern haze of morning.

recent months even temporary settlements have not been maintained here; people refused to live in the middle of the South Atlantic, 700 miles from the nearest point in South America.

Pirates once brought their gold to the valleys where we sought giant land-crabs and specimens of the 30 species of plants found on the island. Many treasure-hunting expeditions have visited its shores. Some failed to land; others succeeded, and many lives were lost through hardships experienced; but none have ever found the two lots of buried treasure which certainly still exist on the island (see pages 42, 43, and 44).

WRECKED ON PIRATES BEACH

We had great difficulty in making landings at times upon the rocky shores. Our dory was battered time and again on the reefs and our whaleboats had to be reenforced.

Landing was especially difficult in Prince's Bay, where the striking peak of Sugarloaf rises straight up out of the sea for 1,200 feet, backed by ridges of phonolite and slides of tufa. On one occasion we edged in toward Pirates Beach, dropped out a cage anchor astern, and took in our whaleboat sails. Long John eased the boat slowly in, but before we could make it we saw big seas rolling in toward us.

Cuyler and I shucked shoes and some of our garments. The first sea half filled the boat, followed by a deep trough, which dropped her on to pinnacles of a reef submerged off the beach, and the second and third seas filled her, over-

Photograph by John G. Hesley

ON THE WESTERNMOST POINT OF AFRICA

Four naturalists from the moored *Blossom* dicker, in sign language and French, for watermelon with Dakar's pier guards, laborers, and washerwomen.

turned her, and battered holes in her thin hull.

We rolled ashore in one grand tangle, José and I swimming with the camera and bedding. Every one set to work salvaging equipment. We drew the boat up on the sands, where we saw at once we could not repair it until we returned to the ship. We were short of food and water and night was falling. We built a campfire against a huge rock and huddled on the sands in gentle drizzles until the following day, when, half in rags, we climbed up toward the top of the island and worked our way down from an 1,800-foot ridge, through magnificent forests of tree ferns, to a cave facing the ship, where a party of our collectors was camping.

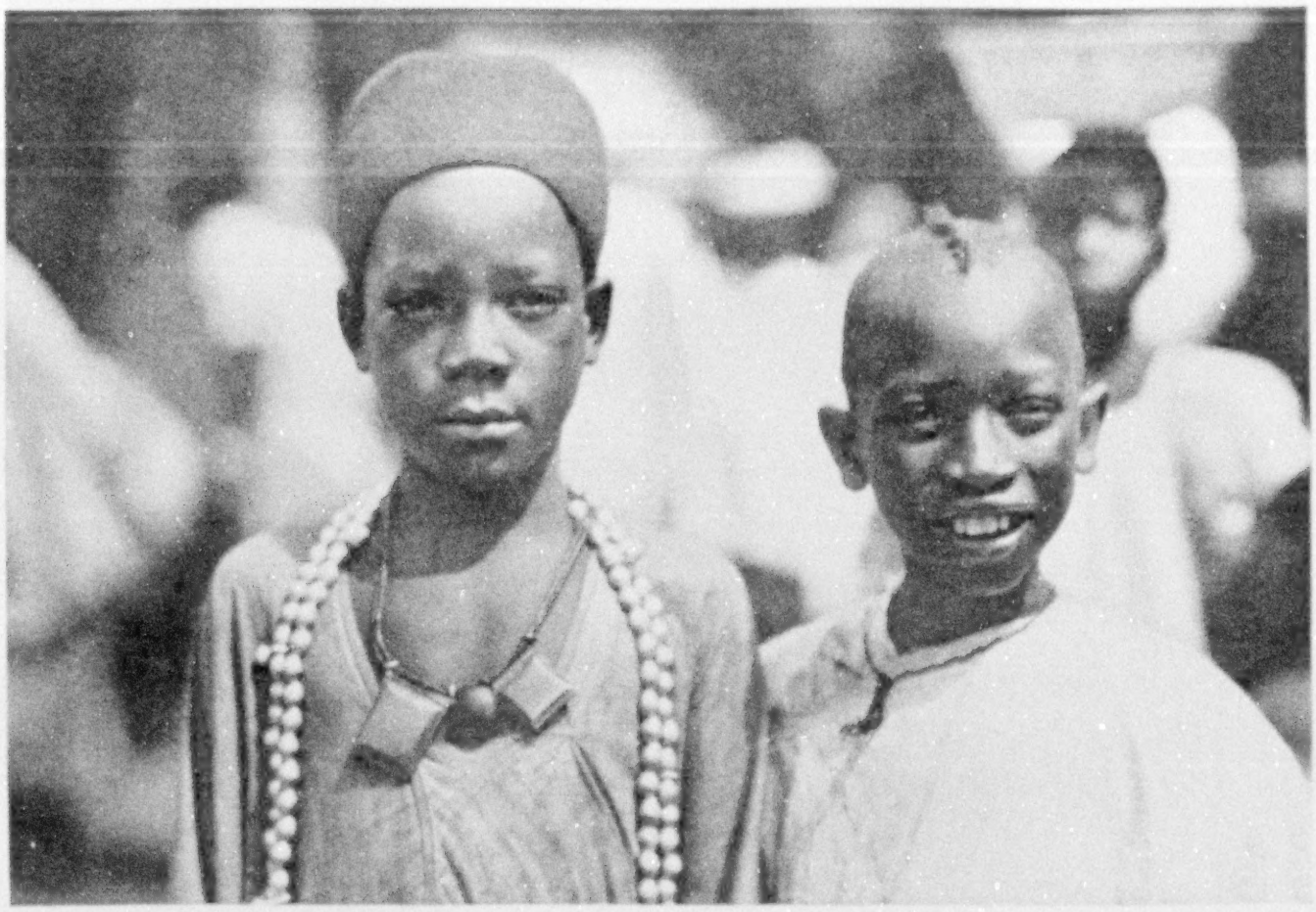
Day after day we searched the slopes and valleys for earthworms, insects, and animals of all sorts—anything which might throw light on the past history of the island and the development of its life. Wild goats and wild hogs, descendants of animals liberated on the island in 1700 by the astronomer Halley, roamed the ridges; and the hogs grew fat from eating the so-called ferocious land-crabs, while the goats were thin on a diet of hard, grisly plants.

The waters about the island teemed with fish, and we listed more than threescore kinds, many of which were edible. In fact, we ate fish every day, three meals a day, while we were anchored alongside the island.

With the lure of the pirates' island still undimmed, but with a third of our men sick with fevers and incipient pneumonia, we spread sail and made for the port of Rio de Janeiro and a hospital.

IN THE LAND OF MILK AND HONEY

With nine days of fair sailing over a pleasant sea, we rolled down from Cape Frio to the entrance to the harbor of Rio. We had no sailing directions or charts for this section of the coast, many of our records having been appropriated by one of the men who left the crew in Africa. So we had to feel our way in between the offshore islets until we could pick out the famous landmark of the original Sugarloaf, after which Trinidad's peak had been named. Fortunately, steamers were



Photograph by Geo. Finlay Simmons

MOHAMMEDAN BOYS OF SENEGAL WEAR "LIFE-INSURANCE" CHARMS

These leather lockets contain, in Arabic, the medicine man's blessing and assurance against drowning, murder, snake bite, and accident.

constantly entering and departing, and we eased gently in.

The narrow entrance widens into beautiful Guanabara Bay, up which we sailed for several miles to an anchorage in front of the municipal quays. The great metropolis of more than a million people lay spread out before us, along the scallops of the bay, backed by the gigantic, precipitous peaks of the Organ Mountains, heavily clothed in tropical forests.

Our men were soon in hospital, in charge of an American physician, Dr. Pyles, and we set about the slow work of getting them on their feet and replacing the Caboverdean sailors, who here jumped the *Blossom* for easier work on Brazilian steamships.

Cuyler collected water birds about Guanabara Bay and a few specimens were taken in the interior toward São Paulo, but most of our time during a period of weary months was spent in locating a dry dock for the ship, arranging for storage, and in checking all our equipment and supplies. We also interviewed hundreds of possibilities to fill the gaps in our crew; but none of the applicants wanted to go to sea on a sailing ship.

There is an American colony of about 2,000 in Rio, including members of the diplomatic corps and representatives of American business interests. The chief of the American Naval Mission to Brazil and his staff were especially kind to us, as were also the secretary of the American Embassy, the American military attaché, the American commercial attaché, and members of the consular service, who aided us in rebuilding our broken crew and getting our ship overhauled for another long voyage.

DIFFICULTIES IN RECRUITING A CREW

The *Blossom* was finally put on the ways. Her copper sheeting was found to be falling to pieces, after a year and a half at sea without inspection, and considerable ship carpentry was necessary, as well as a new coat of paint. We recut all sails, sewed new deck awnings, repaired

Photograph by Robert H. Rockwell

THE WATER HAZARD OF THE AFRICAN BUSH

Hunting during the rainy season in the Bondu country of Senegal has its disadvantages. The *Blossom's* collectors had great difficulty in Fording rain puddles.

Photograph by John G. Hesley

A REAL, NOT A REEL, SHEIK

This Ouolof chief of the Senegal village of Thiès was a bit fearful about facing the camera, and his Mauretanian dancing women were equally nervous (see, also, text, page 23).

Photograph by W. Kenneth Cuyler

EXCEEDINGLY RARE IS THIS SHORT-MANED LION OF GAMBIA

The grizzled monarch of the northwest African bush differs from the ordinary African circus lion of trophy hunters. Rockwell, taxidermist of the *Blossom*, is standing over what is probably the first specimen ever brought back to America (see text, page 24).

all equipment and boats, and got ready for sea once more. Our cargo of specimens had been shipped home and lengthy reports made on our explorations. We now had space for new supplies, which were specially prepared in Rio.

E. Keble Chatterton, in his classic tales of sailing ships, points out that it "is difficult nowadays to get hands to sign for a sailing-ship voyage; even for coasting work they prefer to go to sea in a steamor motor-ship." And there lay our greatest difficulty.

Shipping was brisk and sailors were few in Rio, and we were bound for bad seas of the South Atlantic, in which we expected to cruise for nearly a year. Why should a sailor work long hours under such conditions when he could choose comfortable steamships bound on short cruises for beautiful ports, with short hours, fresh foodstuffs, and good pay into the bargain?

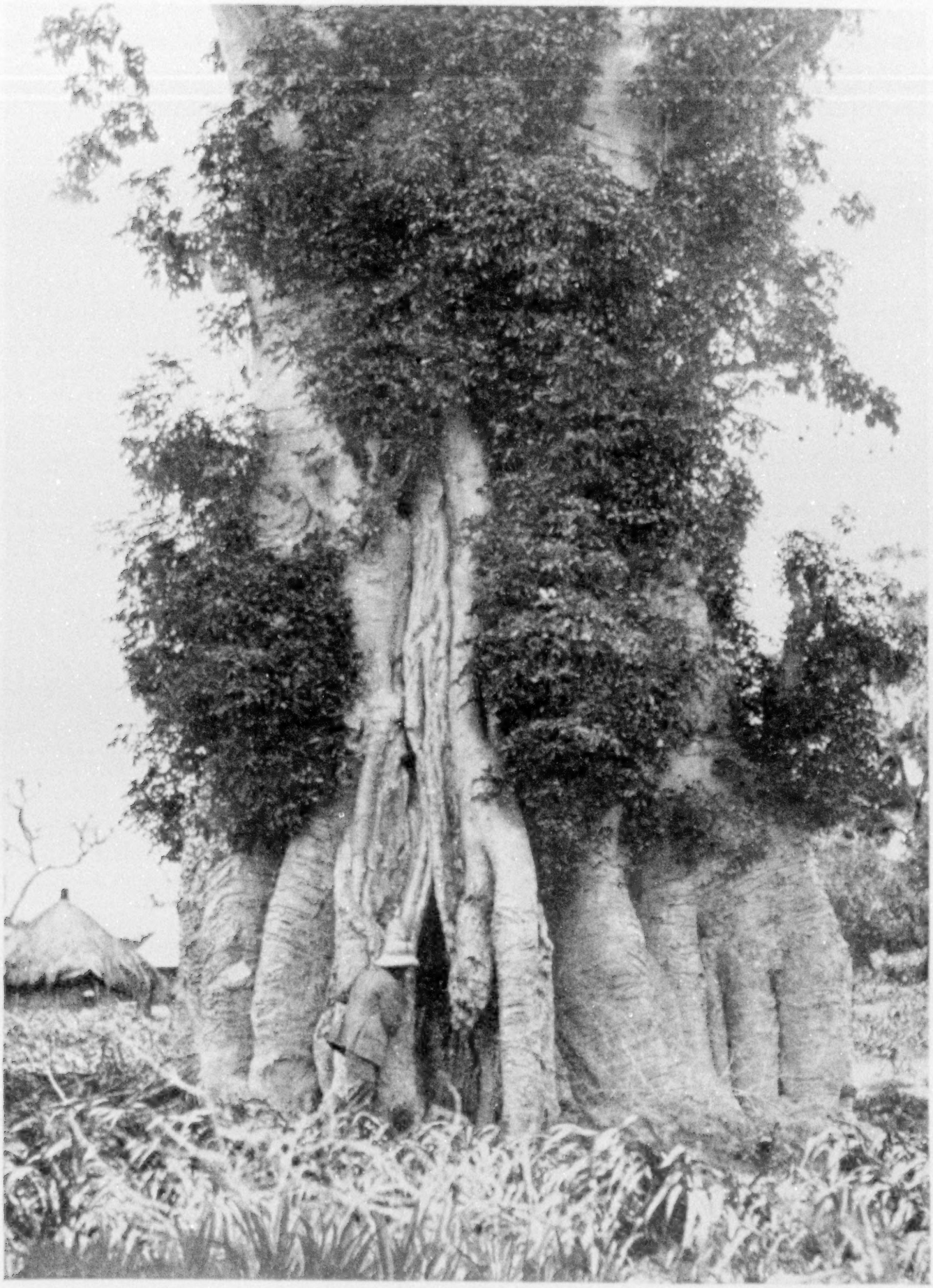
At last, however, we assembled a satisfactory crew and early one morning during the Antarctic winter of 1925 we sailed down Guanabara Bay, out into the Atlantic, and headed southeastward for the waters inhabited by the albatross.

THE ANCIENT MARINER'S BIRD

Down in the South Atlantic, where the wintry winds blow almost a gale from the west and the seas roll mountain high, Samuel Taylor Coleridge's Ancient Mariner once roamed.

I hesitate to write about this part of the voyage of the *Blossom*, for after the Ancient Mariner told about some of his experiences there he was called the world's greatest bore. That pigtailed, tarry seafarer told a perfect stranger, rushing along the streets to a wedding, the "ghastly details of a series of reports on atmospheric phenomena upon the high seas in distant latitudes," and ended his long-winded yarn by relating how "somebody with a bow and arrow went and, without any provocation whatsoever, shot somebody else named Albert Ross!"

We edged the *Blossom* into the fringe of Antarctic winter and rolled and pitched eastward, sailing along before the steady



Photograph by Geo. Finlay Simmons

THE GIANT TREE OF TARTARIN

Hesley, like Daudet's famous Tarascon hunter, in Senegal meets the African baobab. Concealed in its heart were several fat pigs, content in their strange muddy sty.

Photograph by Geo. Finlay Simmons

FISHING FROM THE QUARTER-DECK

Fish are exceedingly rare in the open sea, away from island or continent. There is always much excitement on a sailing ship when fish come about.

westerlies, searching for rare wanderers of the southern seas.

We were running down our easting on the thirtieth parallel, with the Antarctic winter bringing the Roaring Forties ten degrees nearer the Equator. Accompanied by tempestuous seas and with the wind rising almost to hurricane force at times, we raced along, making a best day's run of 178 miles. It was racing speed for us, who were well content with any progress at all under sail. We had done better in the North Atlantic on one occasion, but even then we could never imagine ourselves as contenders for such honors as were won by the British speed-clipper *Cutty Sark's* 363 miles in 24 hours, or the record of the American-built clippers, *Flying Cloud* with 402 miles and *Lightning* with 436.

Across this part of the seas the raging wind was so cold and piercing that we dug out pea-jackets and wind-proofs of every sort. Mist and spray flew high into the air, and the purling, roaring waves washed continually across the slippery decks.

We had talked a great deal about the size of seas in other parts of the ocean, but here we became accustomed to rolling mountains of water 30 and 40 feet high, which boiled relentlessly down upon us from astern. The *Blossom* climbed each one backward, as they overtook and passed her; up and up she went, until it seemed she could look out over the world,

Photograph by Geo. Finlay Simmons

COOK'S MATE FREDDY AND SEA-COOK WILLIAM LABOR TO FEED HUNGRY SCIENTISTS

The galley was scarcely larger than a bandbox, and in the Tropics it was as much an oven as the big Shipmate range, so that much of the culinary work was done on deck.

and then down into a blue-green valley where but little wind could reach her.

FISHING FOR THE ALBATROSS

One day, as in Coleridge's poem, an albatross crossed our wake and followed, to pick food thrown over from the galley garbage. We had no crossbow aboard with which to shoot it, and even if we used our guns we couldn't bring the ship about and pick it up. So Long John and William baited a large shark-hook with a slab of pork fat and trolled a stout line far astern. Bits of troll bait were cast in the wake of the ship, as she climbed easily up one side of a sea and slid smoothly down the other.

The albatross picked up floating bits with scarcely a pause, as it eased down close to the water, snatching its food with a flick of its powerful hooked bill and slapping the sea with a broad-webbed foot. The quick recovery of its speed was marvelous; it would leave the reaching comber of a giant wave behind and sweep alongside the plunging *Blossom*. Men who had never seen an albatross in flight draped themselves over the lazy bench and across the dory strongback to watch the bird beat back and forth on the powerful spread of its 10-foot wings, which always seemed rigid in its gliding flight.

Some of the seamen were distinctly uneasy, swearing we would be trailed by disaster if we killed the bird that made the breeze blow fair. But William, unafraid of the albatross hoodoo, kept at his fishing and eventually had the satisfaction of seeing the big bird take a great mouthful of bait and hook.

A quick jerk fastened the hook in the horn of the bill, and a clarion of triumph awoke even the men asleep below. Soon

Photograph by Geo. Finlay Simmons

SHARK! SHARK! SHARK!

That's one too many, for there were only two under the *Blossom's* quarter, as Moses pulled on his line and Cuyler made ready to drive home the lily-iron.

the fowl of the Ancient Mariner stood on deck, alive and entirely uninjured, though like its fellows caught during the next few days, it became quite seasick from the motion of the ship! Thus we obtained some of our rarest specimens, but many of the birds which we wanted for our collection would not take the hook, so we planned to pursue these in the whaleboat. In spite of winds and seas, the boat was made ready with well-filled water butt and sealed tins of hard-tack as emergency rations in case she should become separated from the ship; then we bided our time.

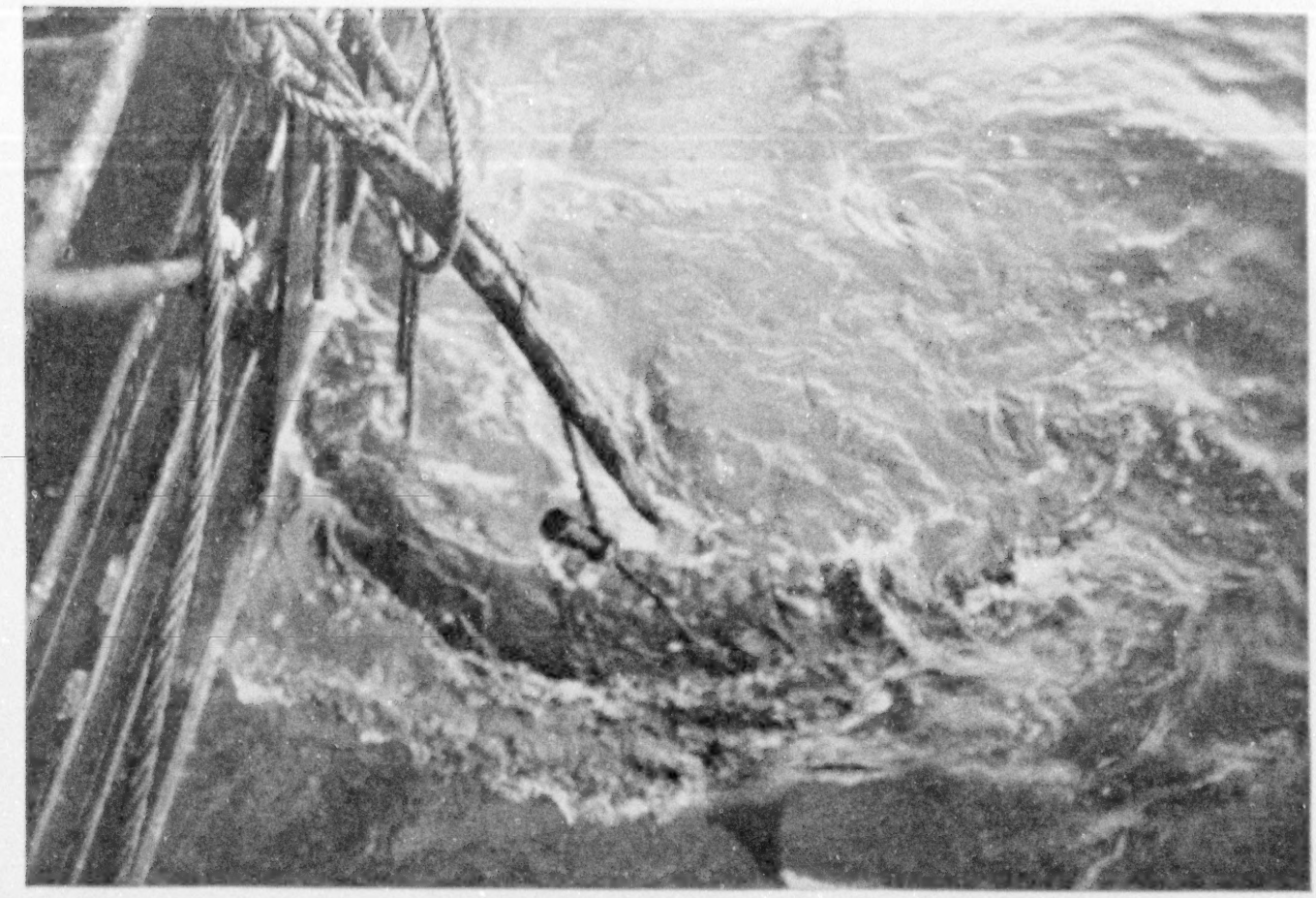
One raw, blizzardy day the rare little white-bellied storm petrel was sighted astern. All about it were cape pigeons, cape hens, the whaler's Nelly, or giant petrel, together with an occasional ghost petrel or an albatross.

Cuyler and his men grabbed their shotguns and leaped into the boat as it hung from the davits; Long John took the tiller at the cry to lower away.

We had no time to brace the sails into the wind and stop the momentum of the ship; so we chanced it, with the powerful wind whoo-whooing in the rigging. Vanzetti and I paid out the line, and the whaleboat slapped the sea.

For a moment it looked as if the men would be poured into the foaming brine. The davit falls caught and the boat was towed along with the ship and slapped against her side. The painter was hauled taut and the falls were cleared as John yelled; in another instant the whaleboat was free, whirling far astern of the *Blossom*.

This and succeeding whaleboat cruises resulted in many interesting specimens being shot and brought aboard, but always these excursions occasioned apprehension, for the boat always got away with difficulty, was only occasionally visible when



Photograph by W. Kenneth Cuyler

DAVY JONES'S WOLF SLAPS THE SHIP WITH HIS TAIL

The ship's cook howled with glee as the lily-iron was driven into the fearsome shark which had followed the schooner for a day and a night.

balanced for a second on the crest of a distant wave, and returned after many anxious hours, when we wondered whether boat and ship would ever meet again. To men in an open boat 1,500 miles from land, it is no laughing matter to see one's ship disappearing, as if sunk into one of the foam-dappled valleys of the sea.

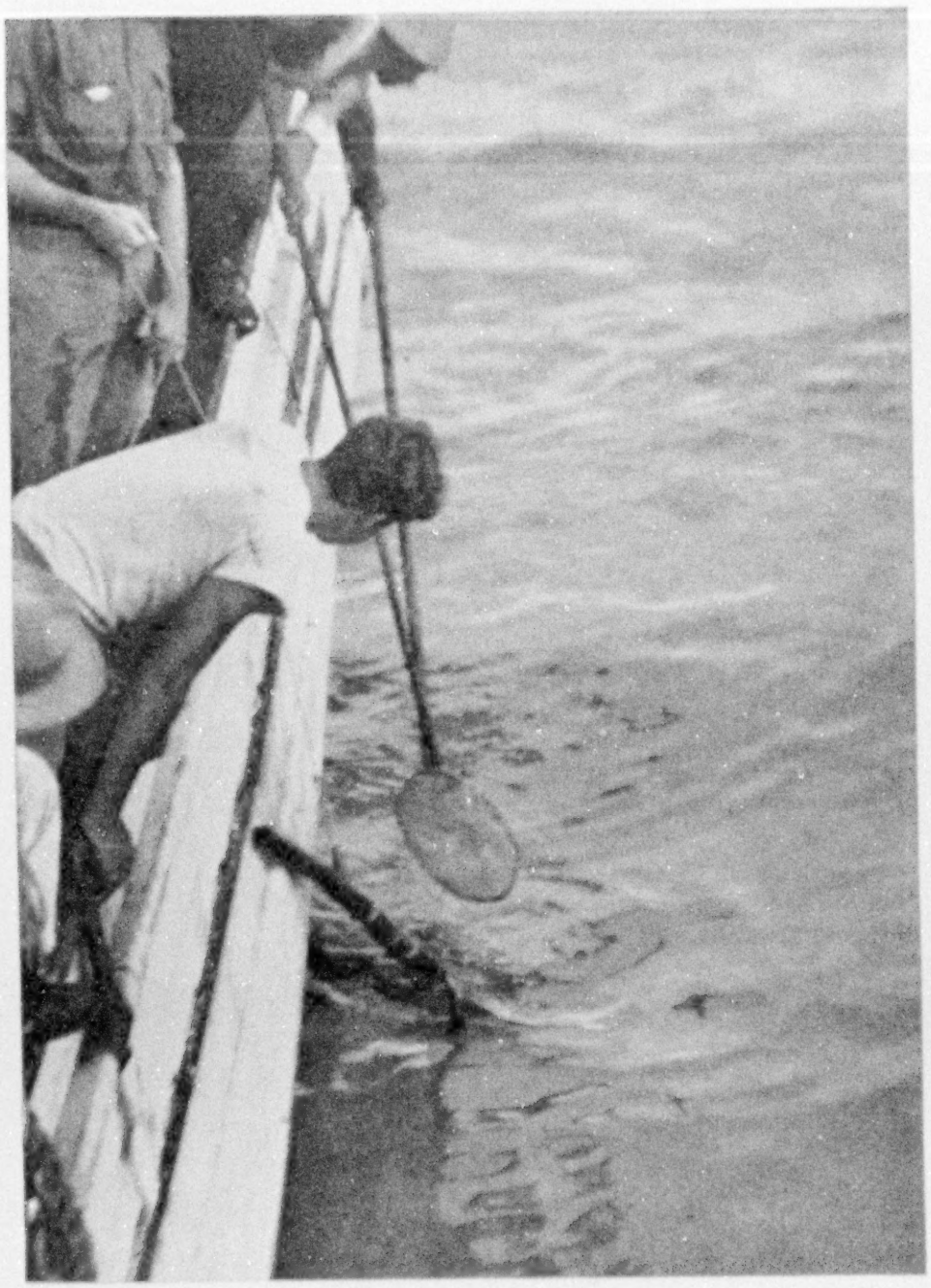
By this means nearly 50 albatrosses of four species were collected, including one of the large snowy variety; several spectacled ones or mollymawks, and more than a score of the yellow-nosed, with a blaze of chrome down the top of their dark bills.

One of the commoner wandering albatrosses, caught from the deck with hook and line, was banded, on the chance that some other ship might recapture it. In a bottle on its neck we placed a brief history of that famous bird mentioned by Dr. Frank M. Chapman, which was bottled December 8, 1847, by the whaler *Euphrates* in latitude 43° S., longitude 148° 40′ W., and recovered 12 days later, 3,400 miles away, by the famous whaler *Cachelot*, at 45° 50′ S. and 78° 27′ W.

BIRDS TOO BIG FOR A LITTLE SHIP

The "stuffed" albatross specimens were so large that we faced a serious storage problem. The difficulty was solved by swinging on deck a huge whaling cask and packing the birds in it. John, with his cask tools and dried flag leaves, headed the cask and made it water-tight for storage in the damp hold of the ship. One of our crew, an ex-rumrunner, suggested we might finance another expedition by inserting several bottles of Scotch or a magnum of champagne into each albatross before sewing it up.

But Cuyler and I were less interested in the present or future contents of the albatross skins than we had been in the meat which they once contained. Not only had we slain the albatross and skinned it into the bargain, but we had eaten it. In the absence of fresh meats aboard, we jumped at the chance to fry small cutlets from the breast of the Ancient Mar-



Photograph by Geo. Finlay Simmons

DIPPING OVERBOARD AFTER THE SHARK'S PILOT

Practically every shark encountered on the high seas was accompanied by small sucker-fish (see illustration, page 41) and beautiful little banded shark-pilots.

iner's bird, and we found them so delicious that we tried stews, hashes, *chili con carne*, and even braised and boiled albatross. The meat was tender and well flavored, and especially tempting was the breast of the yellow-nosed variety. Gourmets may envy.

The crew, however, could never get over its superstition and repugnance at the thought of eating the albatross. They ate their salt meats and dried fish and pitied us.

Thus did we sail for more than a month in the direction of the southern tip of Africa; then turned northward around the imaginary corner of Greenwich and 30° S., and along the path of the old clipper ships and the East Indiamen, rolling down toward the island of St. Helena.

AN EMPEROR'S ISLAND OF EXILE

Early one morning we stood on the deck of our easily rolling craft, feet spread to meet the swing of the quartering seas, and saw the mist-enshrouded mountains and heights of St. Helena materialize through openings in the morning's curtain of haze. Bleak, bare, upstanding it was, as we approached it under shortened canvas.

"What a terrible place to be sent to for a number of years!" exclaimed one of our officers.

He had scarcely spoken when the sun broke through and the whole top of the island appeared blanketed with a green whose varying shades indicated brush, bush, and forest scattered sparsely over cultivated and well-grazed plateaus and mountain tops.

"It appears very interesting to me," said Vanzetti, our Venetian navigator. "I had not realized that there was so much green on top of the island. I wonder if that is Longwood, Napoleon's home, there on the high northern end of the island?" (p. 55).

Tiny gray and white specks, perched on a lofty, verdant plateau, resolved into small houses and outbuildings, under the power of the ship's glasses. Even the sailors wanted to bend over the chart outspread on the cabin roof, to identify Flagstaff Hill, 2,290 feet high; Halley's Mount, 2,467 feet, where Edmund Halley carried on astronomical observations; and

the crest of the island, a semicircular sweep 2,700 feet above the sea, once the rim of a gigantic crater, which blew out toward the sea and left a beautiful valley, the Sandy Bay country, on the windward side of St. Helena (page 57).

It is impossible from the sea to distinguish the three classic summits of this ridge, but we were to find on climbing them that Diana's Peak is higher than either Cuckold or Actæon.

AN ISLAND WITH ITS OWN HISTORY

What an enchanting place to be situated so far out in the South Atlantic, as if forgotten—a *Flying Dutchman* of an island, which many have seen from the decks of passing ships, but at which few ever touch! It is indeed a lovely emerald among the bewildering jewels of the British Crown, with a history all its own. Green, fertile, lovely, and capped by the peak of Diana the Huntress, it stands in splendid isolation, surrounded by forbidding cliffs which rise a thousand feet above a fisherman's paradise.

Photograph from Geo. Finlay Simmons

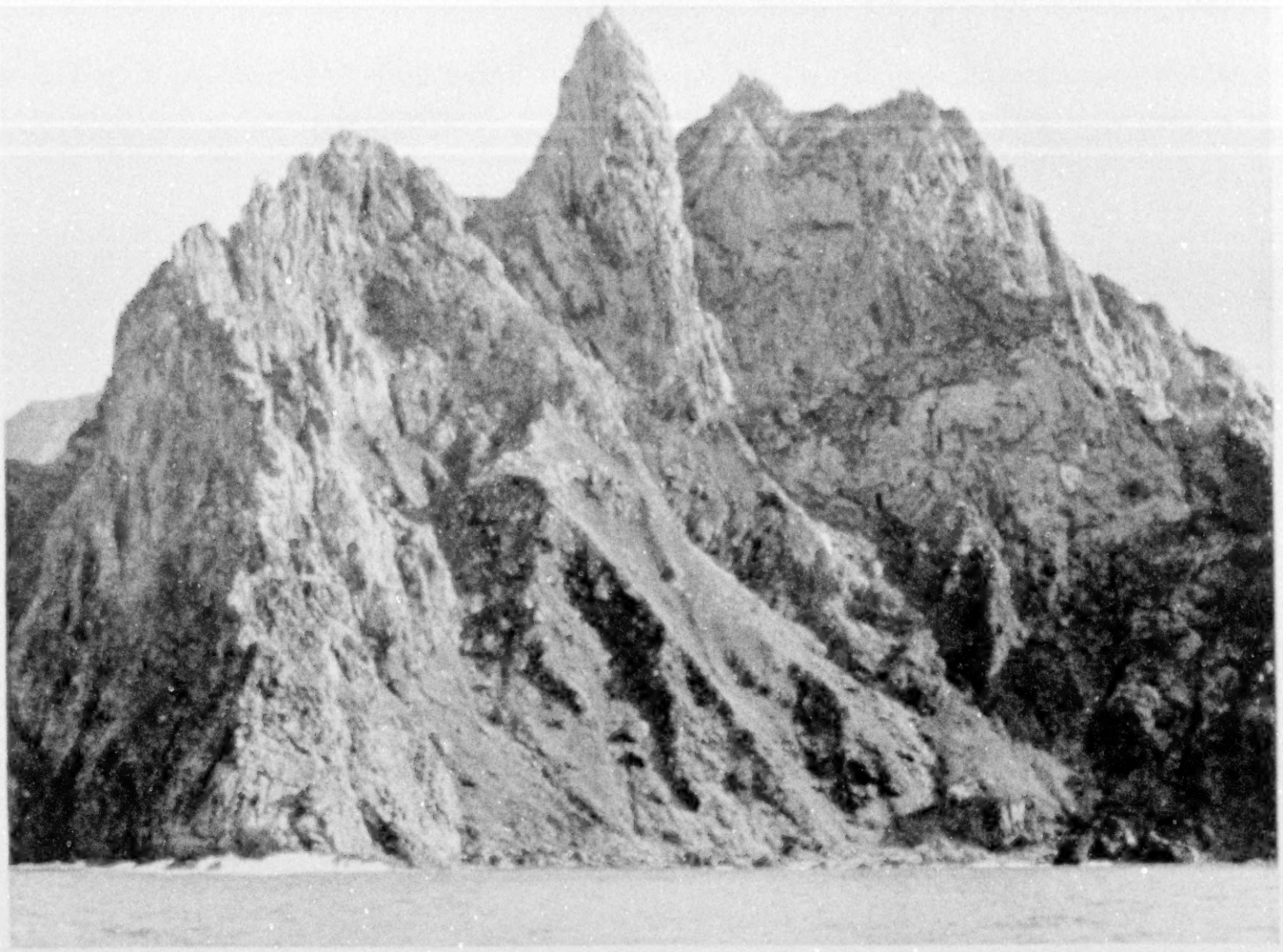
ANCIENT MARINERS THOUGHT THIS LITTLE FISH COULD HOLD BIG SHIPS

The author displays the shark-sucker, which in olden times was said to lay hold of sailing craft and keep them from moving, even when strong winds blew. Sailors formerly watched the sucker-fish; when it was seen to anchor itself to a stone, they made ready for a storm.

It was a hundred years after the memorable first voyage of Columbus that Englishmen learned of the great wealth to be derived from the India trade; and here, on the island of St. Helena, in 1651, the English East India Company established its great way station. By charter from Charles II in 1661, the company assumed a control over the island which lasted for nearly two centuries. The island plantations were cultivated with slave labor; and fresh vegetables and meat animals were provided for the ships which touched here on the voyages between England and India.

The monopoly of the Indian trade by the East India Company was abolished in 1813, with the result that there was a sudden growth of shipping and competition. The China tea clippers, queens of the oceans, began to touch at the island for supplies as they raced home from the typhoon seas.

For six years St. Helena was the home of the exiled Napoleon, who was brought



Photograph by Geo. Finlay Simmons

TREASURE ISLAND AT LAST!

The north end of distant South Trinidad rises for a thousand feet out of the sea, bare and forbidding, to form Cockscomb Ridge and Obelisk Spire.

Photograph by Robert H. Rockwell

FROM THE HEIGHT OF DESIRE, 2,000 FEET ABOVE THE SEA: TRINIDAD

One looks over Scott Peak and Serpentine Ridge toward Sugarloaf, 1,200 feet high, beyond which the sea beats at the foot of Noah's Ark. Between Sugarloaf and Scott Peak lie the Twins, Bingham and Sentinel. One lot of treasure chests is said to be buried in the shadow beyond Sentinel (see text, page 28).

Photograph by W. Kenneth Cuyler

SALVAGING, IN THE ROARING SURF OF PIRATES BEACH

Battered on submerged fangs of Treasure Island, overturned and thrown ashore by the seas, the *Blossom's* whaleboat lay on Pirates Beach while Alfredo and the author plunged into the breakers to recover clothing and gear.

to the island in 1815 and died at Longwood, on a wind-swept, tree-dotted plateau, in 1821. The shaded Glen of Silence opened to receive his body and held it until 1840, when it was removed to the magnificent mausoleum on the banks of the Seine (see page 54).

We landed at Jamestown, just a village, but the only settlement on the entire island worthy the name. Three or four hundred men, six or seven hundred women, and so many children that they get under foot and are counted four or five times, swell the population to nearly two thousand. Quite different from the usual island youngsters are the children of St. Helena. Shyly they eye the visitor, never importuning him in whining note for coin of the realm (see, also, page 55).

The people of St. Helena tell you that anything will grow on the lovely green slopes of their gentle upland hills, and you may well believe them when you learn that more than a thousand species of flowering plants have been recorded from the island.

The ring-necked pheasant is fairly common and a few red-legged partridges occur on grassy slopes; the St. Helena plover, found nowhere else in the world, cousin of a West African species, we met in considerable numbers on wiregrass pastures, and the New South Wales ground dove is fairly familiar, especially about Jamestown. In the trees of the island we saw numerous Napoleon birds or wax-billed weavers, South African seed-eaters, Madagascar cardinal weavers, Java sparrows, and myna birds.

"We've got the best place in the world to live," the St. Helena people say. They know it, though few have seen any other place.

Many middle-aged people born in Jamestown, deep in its narrow valley by the sea, have never journeyed even so far as the several miles of good road leading to Napoleon's tomb and his home at Longwood. Once an aged man, born and reared to manhood in the beautiful, green half-crater of the Sandy Bay country, on the opposite side of the island from Jamestown, was finally taken to the break of James Valley, 700 feet above the village housetops. He caught his breath and said:

Photograph by Geo. Finlay Simmons

SHIPWRECKED MARINERS FIND A CACHE OF FOOD ON PIRATES BEACH

The giant green turtle crawls upon Trinidad to dig a hole for a hundred giant eggs; departing, she leaves behind her footprints on the sands. Hesley and Cuyler, cast ashore, eye her trail to the sea.

"If this city of London I've heard about is half as pretty as Jamestown, it must be a wonderful place."

Our sailors were eager for land, after a month and a half at sea, and went ashore at this "wonderful" place to stretch their legs, see the sights, and meet the people who thronged the water front of the little village.

After two months of steady work over the sides and top of the island and around its shores and water, we hove anchor and moved gently northward 700 miles on winds surprisingly light.

ON THE FORTRESS OF A WINGED PIRATE

Again came a dawn when we sighted another mid-ocean island, Ascension. We lowered away our starboard whaleboat and, as the ship in Vanzetti's charge slowly worked toward the northeast, we sailed speedily toward the island. Approaching from the southeast, we soon made out our objective, Boatswain-bird Islet, famous seabird fortress, which we intended visiting before we arrived at Ascension's anchorage and even before we had been given *carte blanche* to explore the island.

Bo's'nbird Islet's glaring white rock rises straight out of the sea for several hundred feet against the ominously dark colors of volcanic Ascension and the deep cobalt of the seas. Occasional seaward faces of the vertical cliffs are broken with ledges and terrible slides, and with the glasses, on nearer approach, we could see that these were covered with birds, most of them blue-faced boobies *(Sula dactylathra)*, first described from the islet a century ago (see page 62).

Other birds appeared as we drew near

in our whaleboat, running under full sail, and these held the greater interest for us. They were the men-o'-war, or frigate birds (*Fregata aquila*) of Ascension, the original species named in 1758 by the great naturalist Linnæus and now known to be confined to this little oceanic rock.

A FEATHERED BUCCANEER

No specimens had ever been brought to America for comparison with the later-named West Indian species; hence we marooned Cuyler and his four men on the islet with a small cask of water and a little food, so that they could carefully choose and prepare specimens of the booby, the man-of-war, the brown noddy, the black noddy with cap of white, the yellow-billed and the red-billed bo's'n-bird, the white love-tern, the sooty tern, and the Mother Carey's chickens which nest here.

Photograph by Robert H. Rockwell

TREASURE ISLAND'S MAN-OF-WAR

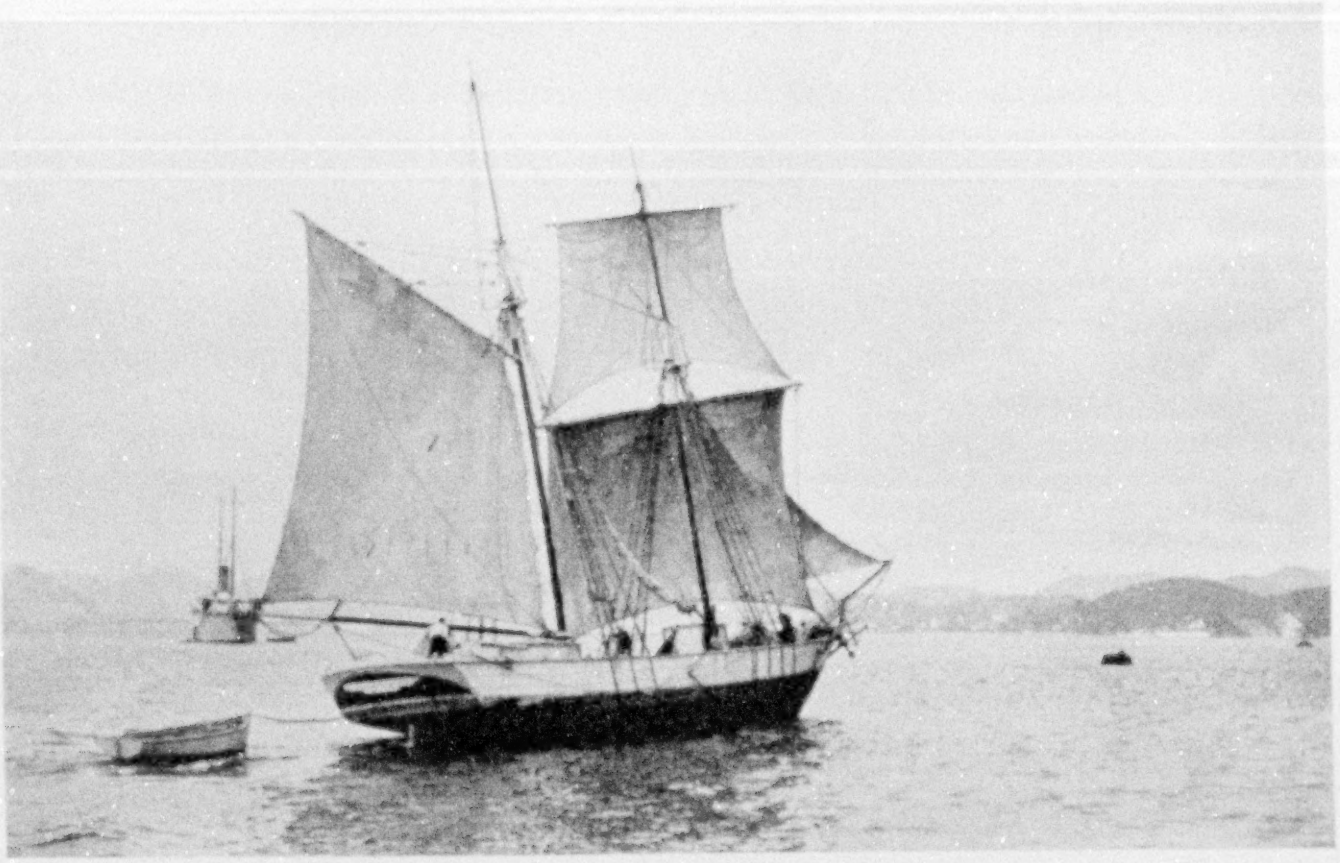
Here is the young warrior, his cradle, and his mother. The fallen tree is a broken fragment of the rare species of brazilwood (*Cæsalpinia*) which once covered the island in giant forests.

The man-o'-war is is an odd sea bird, with a body about the size of that of an ordinary barnyard hen, monstrous long wings, spreading as much as 10 feet; a long bill with hooked tip that makes a dangerous weapon, and tiny feet so weak that the bird can scarcely waddle.

With such equipment, the bird is an accomplished aëronaut, circling and diving in mid-air with lightning speed, or hanging on motionless wings in the teeth of a gale without losing ground. It gets its name from its habit of dashing forth, after the manner of the old-fashioned frigate ship or full-sailed man-of-war in pursuit of a merchantman, and playing the villain's part with the peaceful booby returning home from the sea with a maw full of fish for the powder-puff youngster on the islet's battlements.

The frightened booby squawks and dodges, but it cannot escape the threatening pirate bird; so in despair it disgorges in mid-air and makes its escape, while the man-of-war dives like a plummet, recaptures the morsel before it drops into the sea, and makes for its own youngster atop the islet or lies in wait for another encounter.

Marooned on this islet for nearly a fortnight, where not a sprig of green or a drop of water can be found, Cuyler and his four men lived in a constant dust of



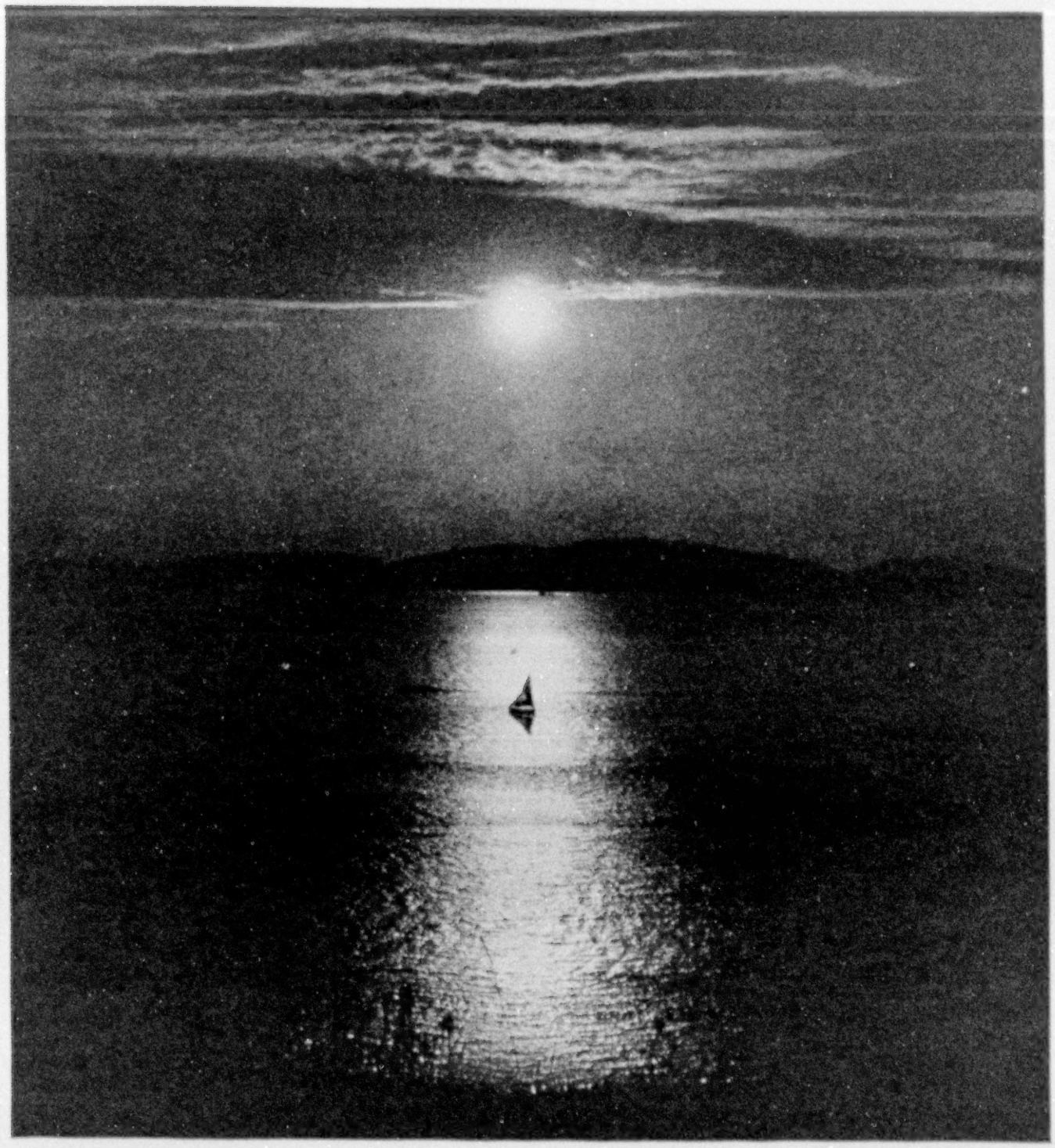
BRAZILIAN COASTING VESSEL ENTERING RIO DE JANEIRO HARBOR

Laden with fruit and vegetables, sailing ships skirt the shores of South America and pick up produce for the large cities.

Photographs by W. Kenneth Cuyler

A SMALL TRADING-SHIP LEAVING RIO DE JANEIRO

A storm brewing beyond the palace of Ilha Fiscal brings wind to the coasting skipper. Ilha Fiscal was once the summer home of Brazil's last emperor, Dom Pedro II.



Photograph by W. Kenneth Cuyler

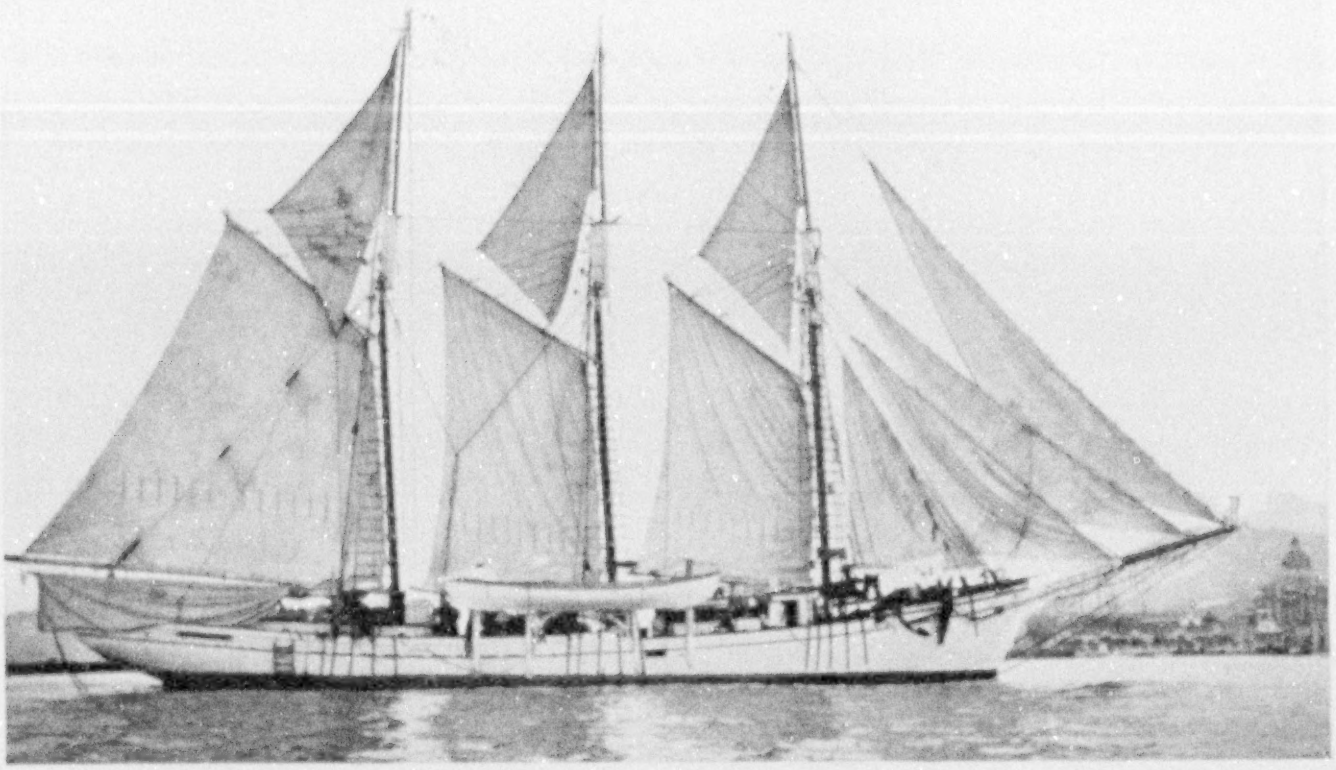
SUNSET ON THE BAY OF RIO DE JANEIRO

guano, with hands and feet gashed and cut by the birds that sit with "sword" ever drawn and ready to slash at the intruder. They were taken off, these marooned mariners of ours, while planning a raft—not of wood, for there was none on the island, but of birds—in case they were not rescued before the last drop of carefully hoarded water was consumed.

JOHN BULL'S YOUNGEST ISLAND

Ascension, near whose iron-bound coast Bosunbird Islet stands, is the volcanic island of a geologist's nightmare — an island terrible, bleak, awesome. As we sailed slowly toward it, the tall central peak gave promise of beauty equaling that of Treasure Island; but, nearer at hand, as we skirted the northeastern shore and came to anchor in Clarence Bay, the island was seen to be the more or less flattened disk of a bare volcanic plain, from which rose the large mountain first sighted, surrounded by a multitude of smaller cones and peaks.

"An island you will never forget," Admiral Newton A. McCully had said to us in Rio many months before we sighted the terrible clinker of the sea. "It seemed as if a mother volcano had squatted on



Photograph by W. Kenneth Cuyler

THE SEABIRD SUNS HERSELF

The *Blossom*, reworked and repainted, dries recut sails after heavy rains in the harbor at Rio. The mountain peak at the right is the famous Corcovado (the Hunchback), from the summit of which the traveler obtains an incomparable view of the Brazilian metropolis (see, also, "Rio de Janeiro, in the Land of Lure," in the NATIONAL GEOGRAPHIC MAGAZINE for September, 1920).

that little-known island and a group of chick volcanoes had settled around her. You will find it the strangest of all the islands you visit."

And the strangest it was. So recent are the formations of this ash-heap of volcanoes that, according to many geologists, it is the youngest of all Great Britain's possessions, if not the youngest island in the world.

There is no good anchorage. Clarence Bay, where we furled sail, is an open-sea roadstead facing Long Beach and the little settlement of Georgetown. Here, on a low, rocky shore backed by clinker plains, the first settlers landed in 1815—a detachment of British who anticipated attempts to use it as a base from which to rescue Napoleon from St. Helena.

Soon the island became known as the only immovable battleship in the world, for she was manned by a ship's crew and officers and was carried on the books of the British Admiralty as H. M. S. *Ascension*, a ship's tender.

Diamond Rock, strategically located on the coast of Martinique in the West Indies, was fortified for nine months in 1803 by British sailors of Admiral Sir Thomas Hood's fleet; from it the Britons harried French ships entering harbors of Martinique.

The rock might thus be referred to as an unofficial "immovable battleship."

SOLAR PLEXUS OF THE BRITISH EMPIRE

Warfare with mid-Atlantic pirates and slave traders compelled Great Britain to develop the hospital service of the island, and it soon became the rest station of the British West African squadron, which three-quarters of a century ago was extremely active and powerful. The Boer War in South Africa added an important chapter. Britain's submarine cable system was spread southward to the southern tip of Africa and Ascension became a relay station to speed up and strengthen signals.

With the death of slave trading and piracy, and with subsequent changes of world interest from warfare and colonization to commerce and necessity for naval retrenchment, the Admiralty in 1922 withdrew its small personnel and turned the island and settlement over to the cable

Photograph by Geo. Finlay Simmons

CUYLER AND HIS MEN, WITH LONG JOHN AT THE TILLER AND SHEET, PURSUE SEA BIRDS IN A FAIR WIND

company, which represents the British Colonial Office in the administration of the island's affairs.

We landed and met the fifty-odd Englishmen who live in the settlement and who keep the great cable station running. They are odd in numbers only, for the majority have lived in the great cities of the Old World, are well educated, and take pride in making possible political and commercial contact between Europe, Africa, and South America.

Ascension is an exceedingly healthful place for children. We saw about the settlement the bright and happy youngsters of more than a dozen members of the cable staff, who had brought wives and families to live with them during their self-chosen exile of three years.

Unless spare time is regularly employed in some form of recreation, and especially the time of the young bachelors, men on the island fall victims to the malady of "Ascensionitis." Symptoms are a lack of interest in work, general irritability, and a longing for the fleshpots of London.

THE BEACHES OF ASCENSION

A famous stretch of white beach lies in a gleaming scimitar along a bight just northeast of the settlement and its landing. But "sand" is a misnomer for the fine white particles here found; close examination shows that each and every grain is a tiny, sea-rounded fragment of seashell, perhaps of triton, nautilus, limpet, or whelk.

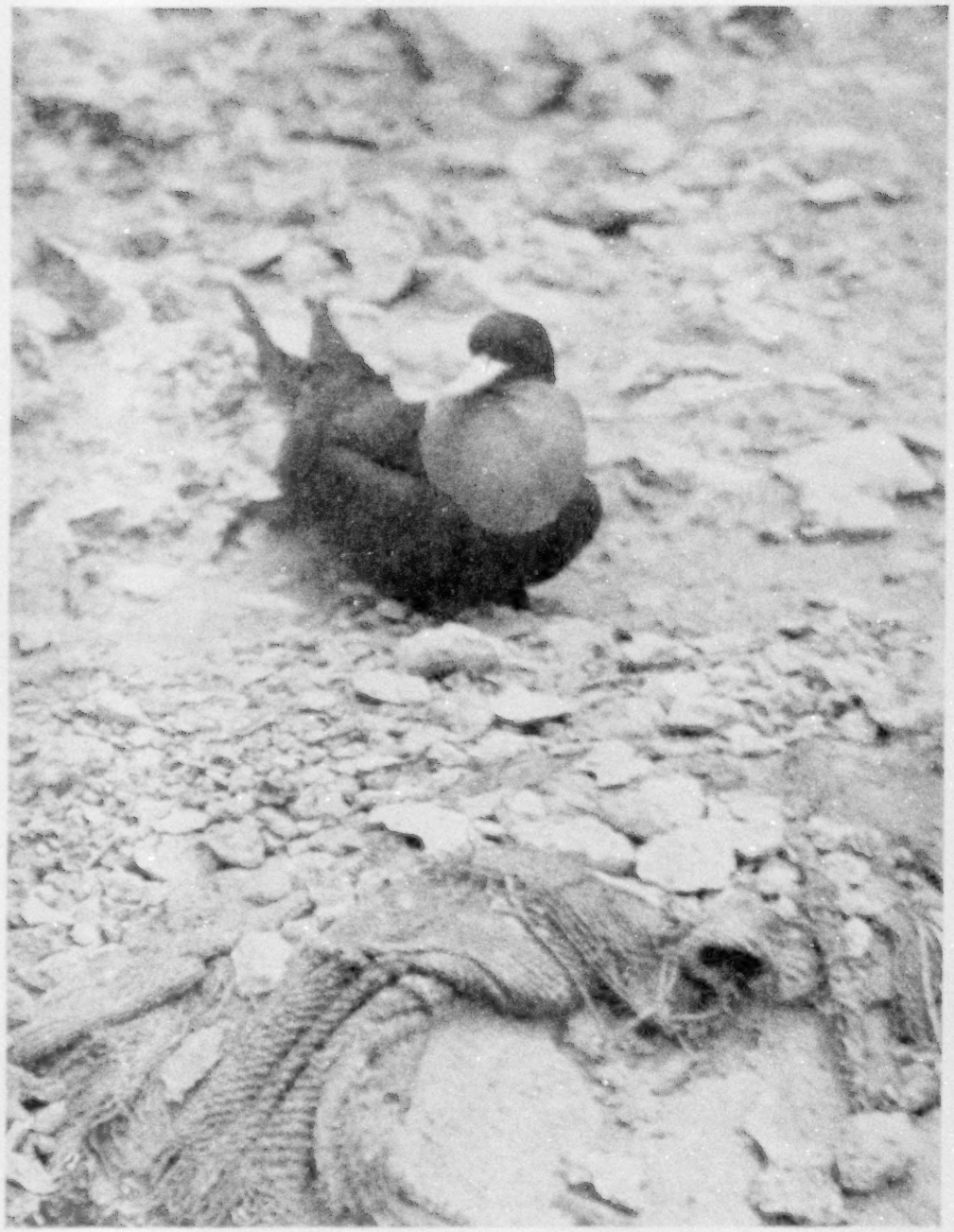
During the breeding season, from November to April, the waters about the island are alive with giant green sea turtles, which lay their big, white eggs on this strand. We captured a number of them for our collections and put others in the government turtle pens ashore—apparently the first males ever taken at the island, since only females go on to the beaches.

Vanzetti and I became beach combers

Photograph by Geo. Finlay Simmons

THE ANCIENT MARINER'S BIRD ON THE WING

Coleridge's pig-tailed, tarry seaman wore a forty-pound wandering albatross around his neck in penance for killing with his crossbow the bird that made the winds blow fair.



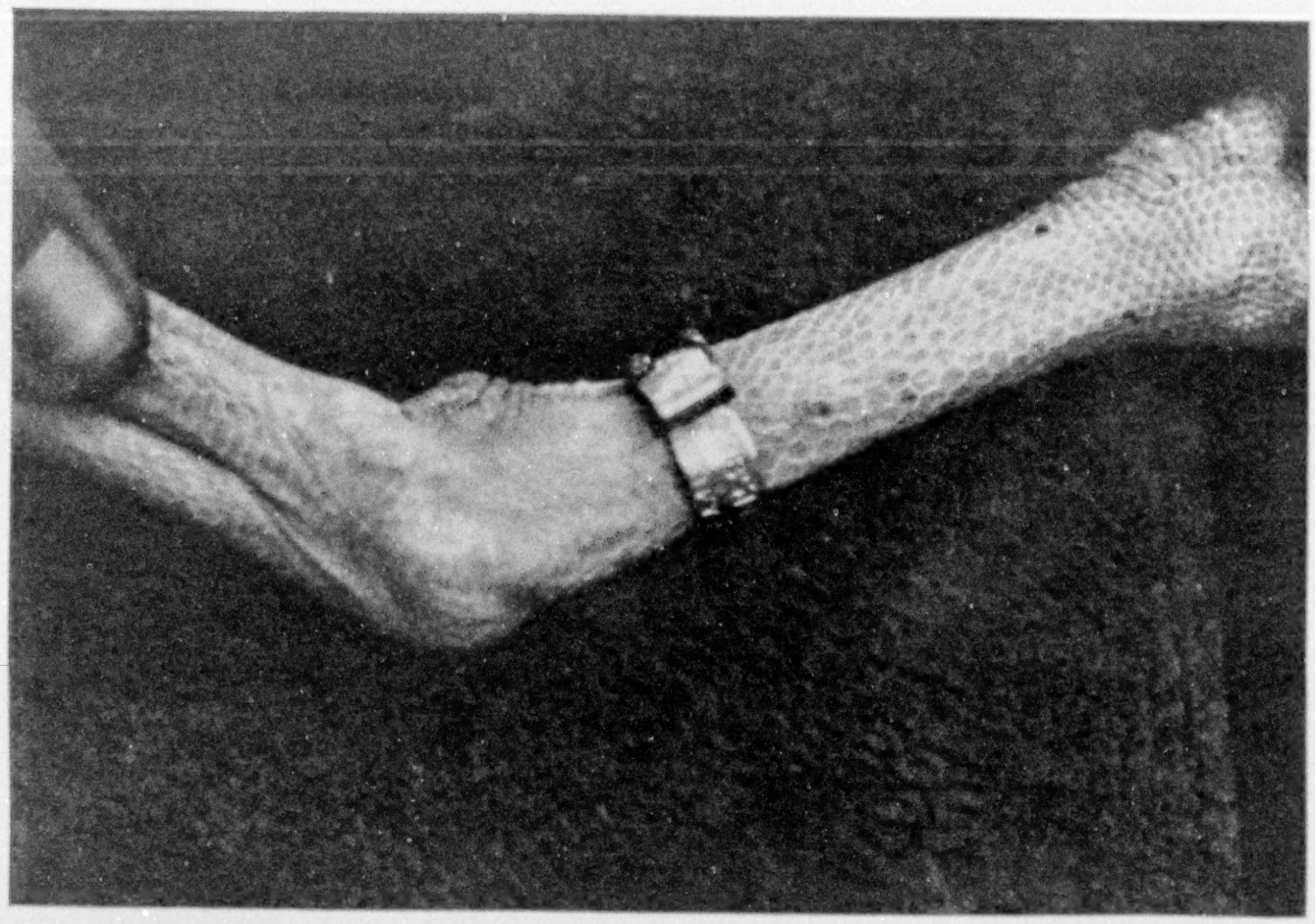
HIS LADYLOVE HAS A MORBID DISPOSITION

The male man-of-war bird of Ascension Island attracts his future mate by displaying, during the courtship and nesting season, a scarlet goiter-like balloon where his human parallel would wear a bright necktie (see text, page 54).

RARE BIRDS OF THE TROPICS

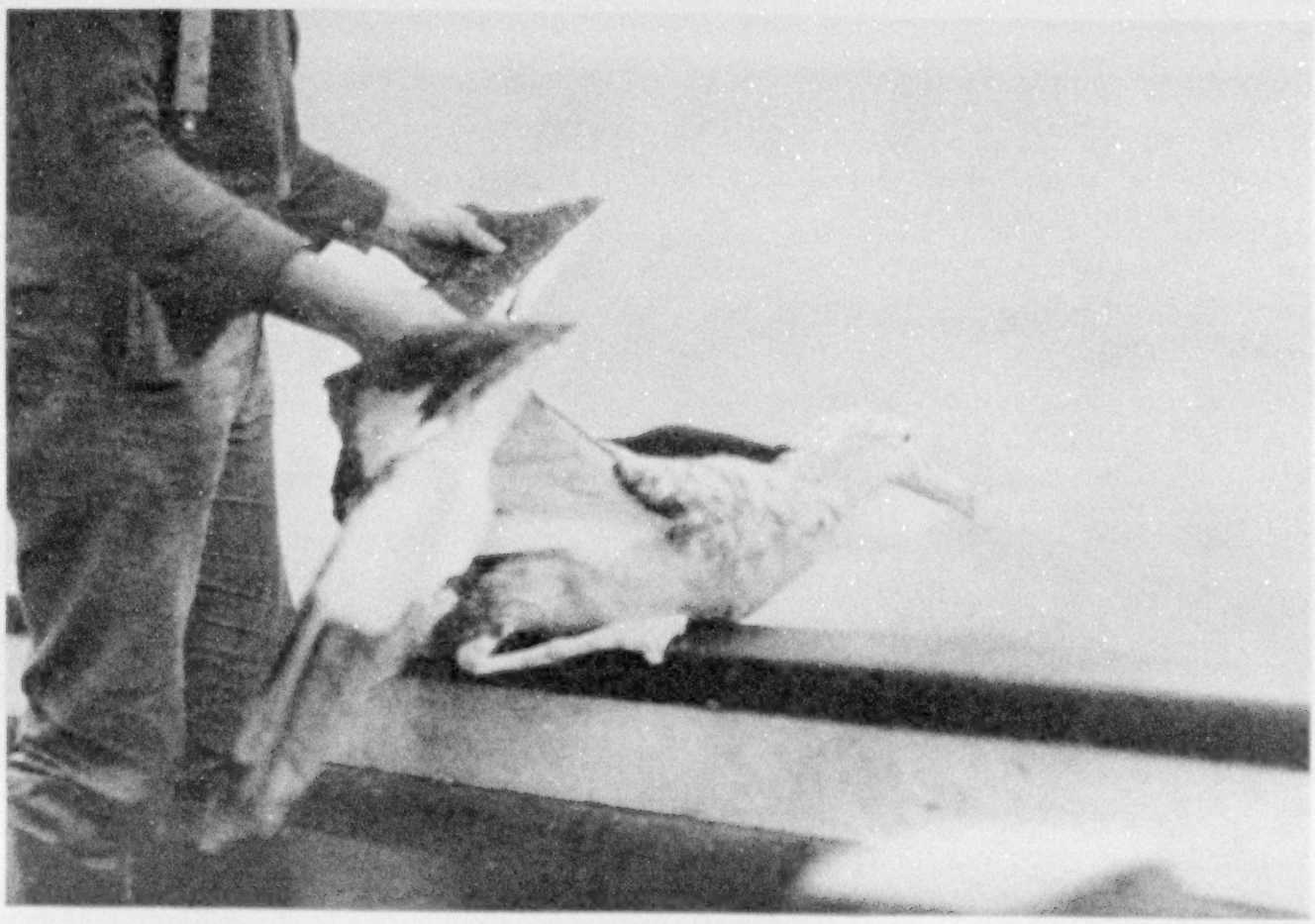
Gaudençia, who was completing his twenty-fourth year on Fernando Noronha for killing a Pernambucan chief of police, helped Cuyler in his hunt for the rare red-billed tropic birds of Brazil's Murderers' Island (see text, page 59).

Photographs by W. Kenneth Cuyler



TAGGING THE WORLD'S MOST FAMOUS WANDERER

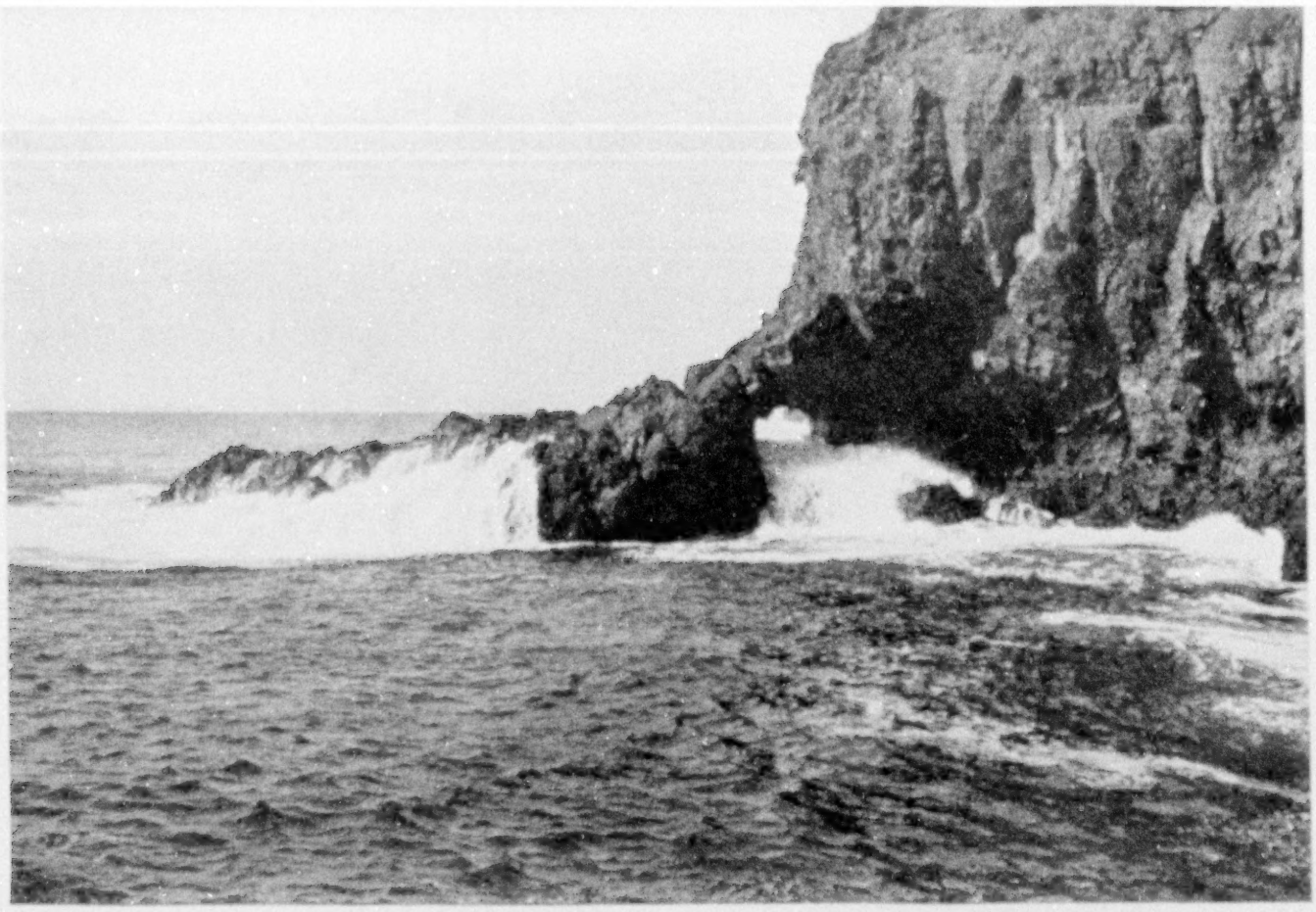
A migratory-bird band of the United States Biological Survey was placed on the leg of a wandering albatross caught and released in the South Atlantic.



Photographs by Geo. Finlay Simmons

RETURNED TO ITS NATURAL ELEMENT

A banded, bottled albatross returns to its fishing in troubled seas.



Photograph by A. E. Young

NEAR THE LANDING STEPS WHERE NAPOLEON DISEMBARKED IN 1815

The sea here pours with a roar through a hole in the basalt face of St. Helena.

for biology. Van left his charts and I left my octavos of science, and at intervals of several days, sometimes by day and sometimes by night, we tramped the shores and beaches, abetted by the busy Cuyler, Brito, and the irrepressible William.

Along the shore reefs we gathered oysters and crabs, spiny lobsters and tiny shore fishes. With the boats we sought porpoises courting and mating in the lee of the island; the giant tuna swinging offshore in schools, in pursuit of flying fishes and turbots; and the myriad fish of many colors which lure the island fishermen out on to the giant swells of the mid-Atlantic.

IN A PRIVATEER'S FOOTSTEPS

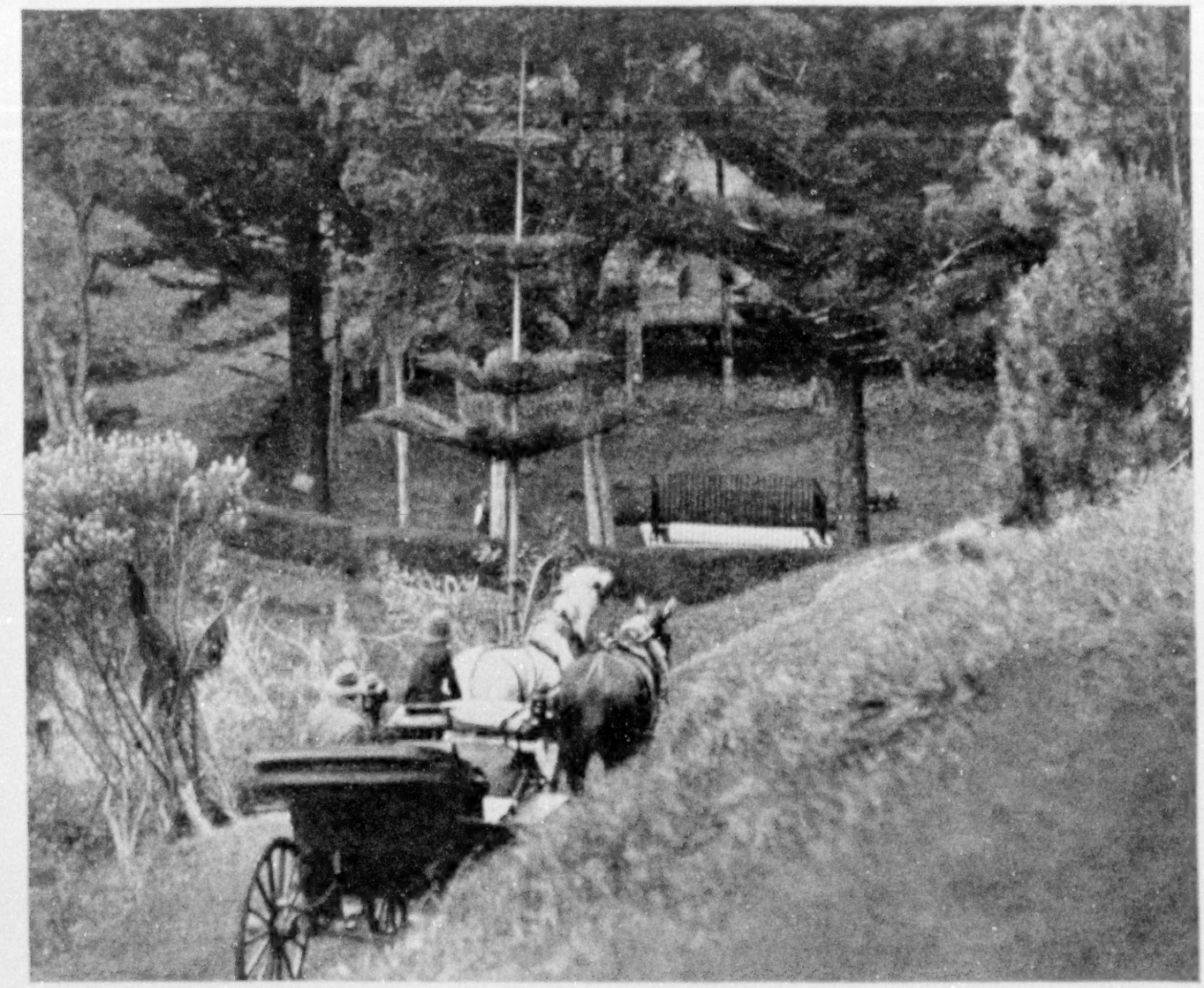
In the meantime Cuyler had taken his band of collectors inland to the base of the big mountain, and they had there become modern cavemen. They settled themselves in a cave at Dampier's Springs, and from there fared forth over lava and volcanic cone in search of birds and mammals. The myna bird, the waxbill, and the red-throated partridge are to be found over the top of the island; a few seed eaters may be discovered by careful searching in the occasional lines of thicket, and rabbits and wild goats are hunted.

Donkeys have been liberated on the island, and they have become so wild that they cannot be approached. One of the amusements of the bird collectors at Dampier's cave was to set traps for them at a small waterhole below their camp.

A GIGANTIC EXPERIMENT

Green Mountain as a name must have been ironic a century ago. It rises for nearly 3,000 feet in a tremendous cone of black and gray cinders, each as big as the end of one's thumb, mixed in with lava and ash. Once the mountain stood out brown and black against the sky, but for a hundred years the men of H. M. S. *Ascension* fought it with the great British naturalists of the nineteenth century as their magi.

Plants were brought from other volcanic islands to break the soil and form a humus; then it was thickly planted with grasses, bushes, and trees from Mauritius, Australia, and the botanical gardens of Kew. Where one plant died, another was set out, until the peak and the elements



Photograph by Geo. Finlay Simmons

INTO THE VALLEY OF SILENCE

On St. Helena, at the head of a shaded valley where Napoleon loved to meditate in solitude, the body of the Emperor of the French lay beneath an unmarked slab for more than 20 years. It was then removed to the magnificent mausoleum on the banks of the Seine.

surrendered. Now the mountain is beautifully green with vegetation that has increased the rainfall to a marked degree—so much so that moisture-loving plants grow there in abundance.

The added rainfall on parts of the mountain above the clouds now goes through pipes to reservoirs at the settlement and enables gardeners to raise vegetables, beef, and mutton for the tables in the settlement (see page 61).

A CITY OF SEA SWALLOWS

An optimistic guano and fertilizer company is working the northern corner of Ascension, where the clinker plains meet the sea. A half-dozen Englishmen live at a small settlement on the edge of the English Bay anchorage and direct the labors of more than 100 St. Helenamen. They work among the dusty deposits of phosphate which have accumulated for centuries in the great holes of the clinker.

There sea birds once lived in great cities and left their guano in countless tons, to be scattered by wind and weakened by rain. Perhaps these colonies were of boobies, man-of-war birds, and terns; but a careful search for bones in the deposits may show that here once lived an extinct species of penguin or perhaps rare sea birds akin to petrel and albatross.

At the present time there is a wonderful city of birds at Wide-awake Fair, on the western corner of the clinker plains. We of the *Blossom* went to the Fair on numerous occasions during the breeding season and found the birds assembled by the millions on flattened areas between the ragged cones. The eggs were in such close

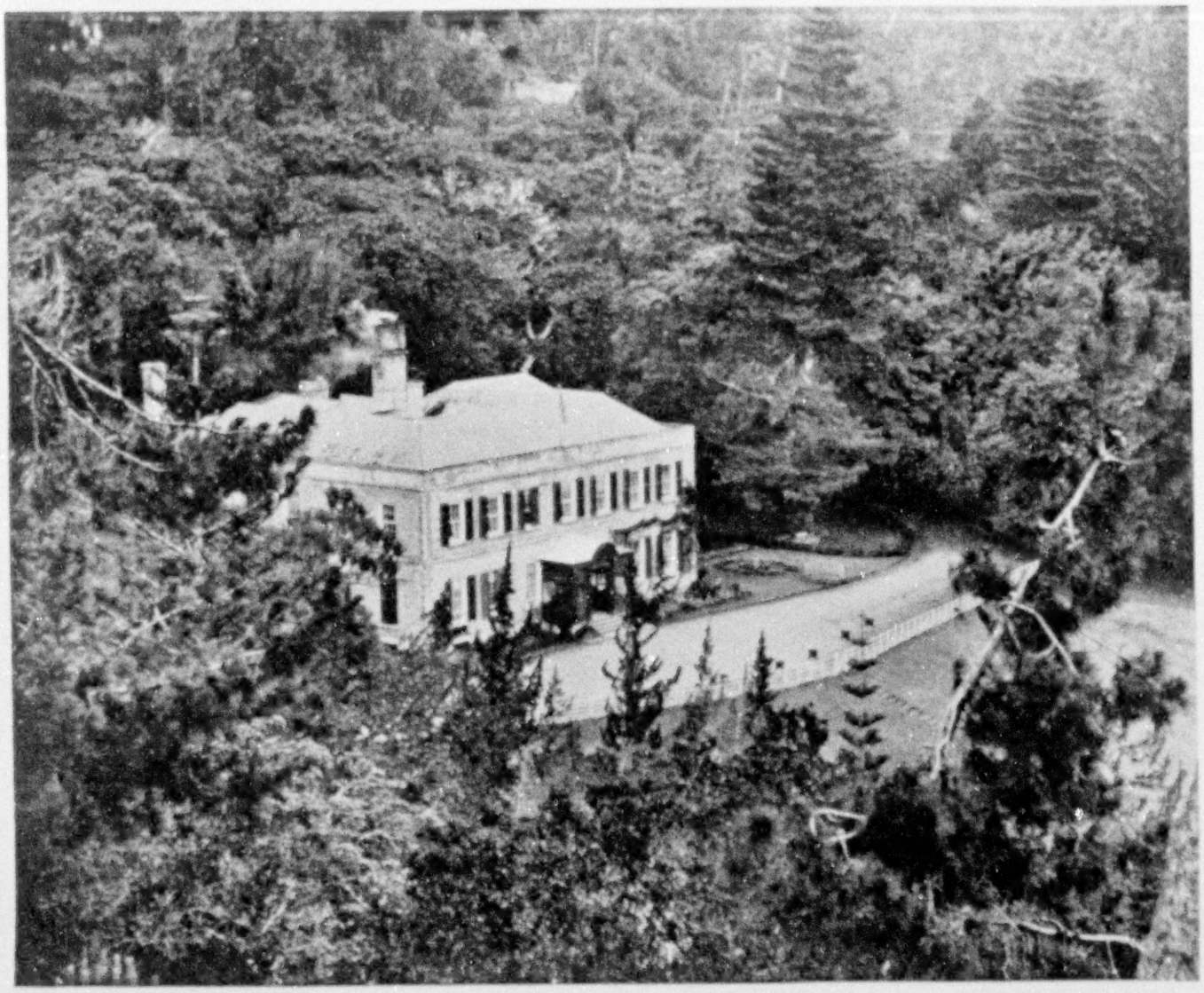
LONGWOOD, HUMBLE HOME OF AN EMPEROR

Here, in peace and study, lived Napoleon Bonaparte for the last six years of his turbulent life, following his defeat at Waterloo and final surrender to the English, who sent him in exile to St. Helena. Many queer Norfork Island pine trees occur on this island (see page 43).

Photographs by Geo. Finlay Simmons

HERE WITCHES WERE BURNED AND PIRATES WERE QUARTERED

Jamestown, the peaceful little village which snuggles deep in a valley at St. Helena's anchorage, has a dramatic history of its own, of oriental shoes and sailing ships and sealing smacks, of cabbage-trees and—an emperor (see text, page 43).



Photograph by Geo. Finlay Simmons

THE HOME OF THE EMPEROR'S JAILER

Here, in Plantation House, the home of St. Helena's governors, more than a century ago lived Lieutenant-General Sir Hudson Lowe, much-abused caretaker of Napoleon.

formation on the ground that it was difficult to step without treading on one or more (see illustration, page 60).

Upon our approach the birds rose in deafening chorus and hung over our heads in a threatening blanket of wings and sharp bills that darkened the sun. As a curtain of birds swung down with terrible chattering and screeching, we always ducked and huddled in anticipation of an attack. Several miles of walking over heated clinkers is not an amusement, and we usually returned footsore and weary.

WHEN THE DORY TURNED TURTLE

On one occasion during our stay at Ascension, when men could not be spared for the whaleboat, Cuyler and José put forth in the dory to capture a big sea turtle. When nearly two miles from the ship they came upon their quarry basking on the surface, and Cuyler drove a small harpoon through the leathery skin of one flipper, while José maneuvered the tiny boat.

With fine skill they drew the turtle alongside, balanced the dory, and took the turtle aboard, since it would have been almost impossible to tow the monster back to the ship. The three of them filled the boat to overflowing, and just as they began their return trip a sea caught them and they were capsized.

The green turtle started for the bottom, dragging giant Cuyler, feet first, by the harpoon line, which had become entangled about his ankles, and when he finally succeeded in freeing himself he shot to the surface, gasping for air.

José tried to right the water-logged dory, but it was no use; so he rolled it upside down, with a large amount of air inside to make an unstable buoy. Both men clung to this, growing weaker in their

Photograph by Geo. Finlay Simmons

FERTILE, TERRACED HILLS OF ST. HELENA

Great quantities of flax are grown on the slopes of the Sandy Bay country, high above the sea. A single tall tree crowns the peak of Diana the Huntress, the crest of this magic isle (see text, page 41).

efforts to stay on top of the water and keep air under the boat. Seas continually rolled the dory over, 30 or 40 times, according to Cuyler, a Texas plainsman, who swims but little and who nearly wore the ends of his fingers off clawing at the sides of the dory.

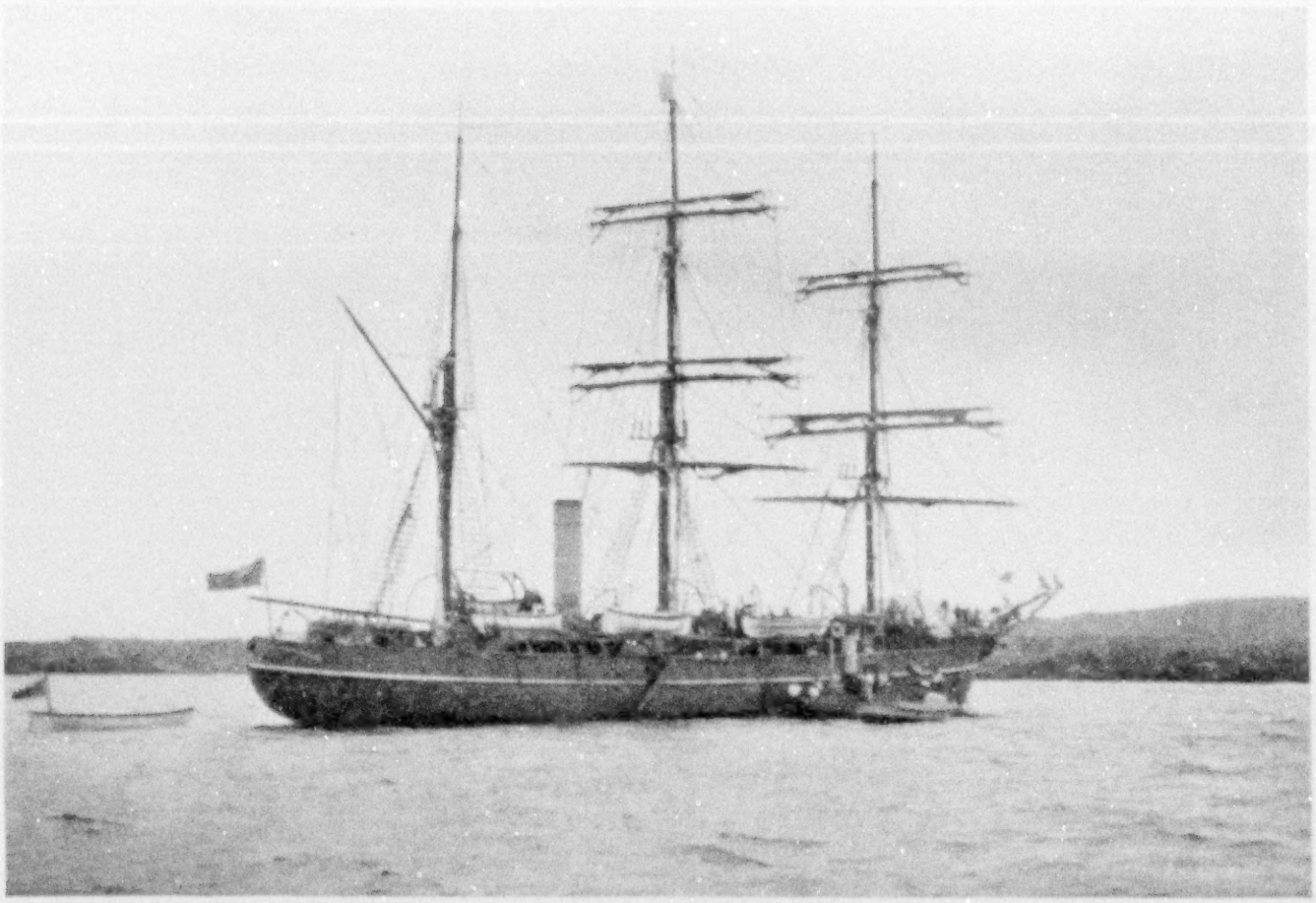
Fortunately, Long John always watched his boats when they were away from the ship. The moment this one overturned he whipped out his glasses, saw what had happened, and sounded the cry to lower away the whaleboat. In racing time a rescue crew sped for the men floundering at the mercy of the sea.

By the time they were dragged into the whaleboat Cuyler and José were close to exhaustion.

Cruising in hot climates fouls the bottom of a ship, but usually a steamer makes many journeys, reprovisioning at port or even coaling at sea, before she goes into dry dock for cleaning. A sailing ship can hold out longer still, especially if she is copper-bottomed, as was the *Blossom*. On the way to Ascension, however, seaweed had grown so rapidly on the copper below the waterline that we felt much concern, for we knew that after our collecting stay at Ascension we should need every bit of speed we could get out of her to make an American port before running short of food and water.

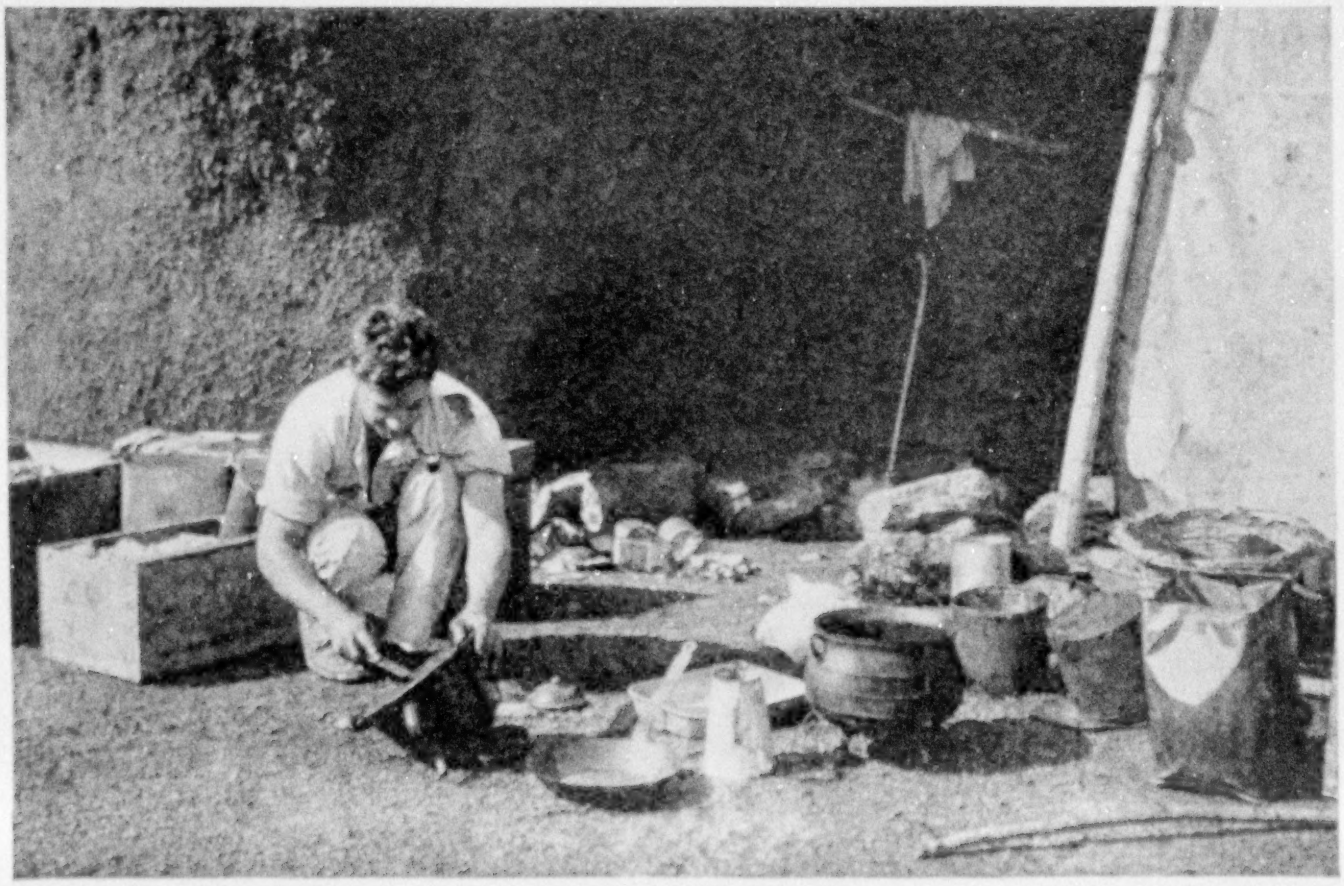
FISH SERVE AS DRY DOCK LABORERS

As soon as we dropped anchor at Ascension the black turbot, or trigger-fish (*Melichthys piceus*), swarmed about the hull. Naturally a lover of seaweeds, they had subsisted largely on refuse and carrion in the waters to the lee of the island. To them the *Blossom* must have seemed



THE "DISCOVERY," SHIP OF A THOUSAND ROMANCES

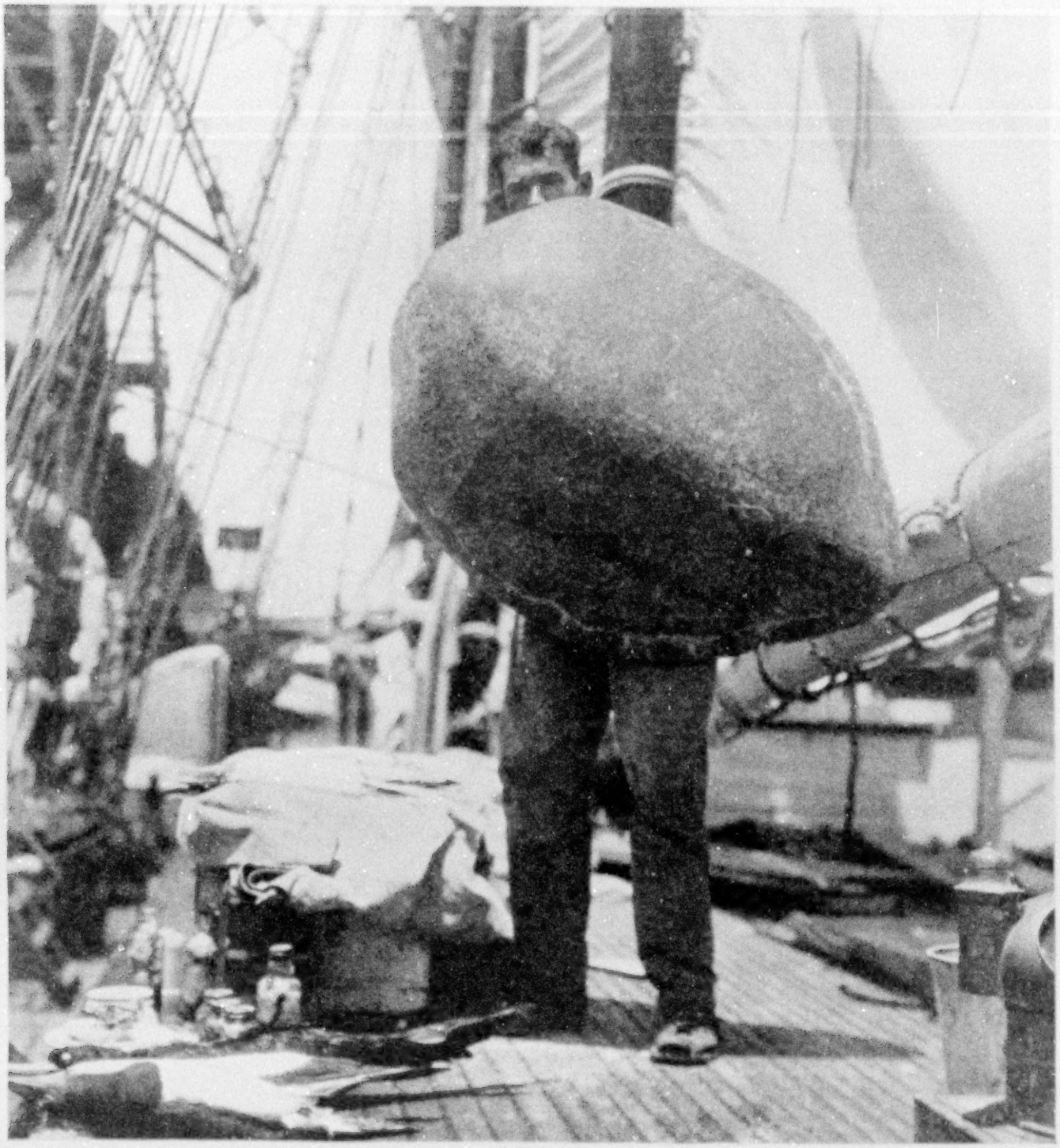
Captain Robert Falcon Scott's famous Antarctic ship, reconstructed, is in commission once more, seeking rare shrimp in distant seas. On her way south she anchored at Ascension for coal and met the *Blossom*, a second strange ship of science.



Photographs by W. Kenneth Cuyler

ON THE TRAIL OF A PIG-TAILED PIRATE

Bird collectors in camp at the cave where shipwrecked Dampier, explorer and buccaneer, once lived on Ascension Island.



Photograph from Geo. Finlay Simmons

A SHIELD FROM A SEA-TURTLE'S SHELL

Cuyler lifting the giant carapace of a male green turtle on the cabin roof of the *Blossom*.

a banquet table, for they soon nibbled every strand of the weed from her hull. They went further than that, for when the giant tuna dashed in toward them they pressed for protection against the copper sheeting and raced forward and aft to make their escape. Their sandpaperlike scales polished our hull until we were as clean as was possible!

Cheerfully we weighed anchor once more and made toward the great right shoulder of Brazil that humps out into mid-Atlantic.

Once under way on the placid parts of the sea, troubles are always forgotten. Occasional Mother Carey's chickens, a shark or two, bonitos and dolphins—these were the markers of our days until we again sighted an island whose fingerlike mountain rose far in the distance, above the curving sea, the way a landfall should be made.

AN ISLAND OF MURDERERS

Fernando Noronha, beautiful and fertile, intriguing and luring one ashore, is a Prospero's isle turned into a place worthy of all of Pandora's curiosity. One

Photograph by W. Kenneth Cuyler

WHERE BIRDS NEST SO THICKLY THAT WALKING IS DIFFICULT

On a corner of Ascension Island known as Wide-awake Fair mysterious swallows of the sea appear and nest by the millions among the volcanic cones; then, the young once fledged, they put to sea and no more birds are observed until they suddenly appear for another breeding season.

looks behind its beautiful woodland cover and sees Brazilian dungeons; for here, on this little dot on the surface of the sea, just below the Equator (see map, page 5), hundreds of the worst murderers that a Brazilian state can send in exile roam beautiful hills and shores.

Here one sees a killer who has slaughtered far beyond his ability to count, there an assassin who would slay for a few milreis; for Brazil has no capital punishment or life imprisonment for murder. A court can give only 30 years for all such crimes in the calendar, and then there is time off for good conduct.

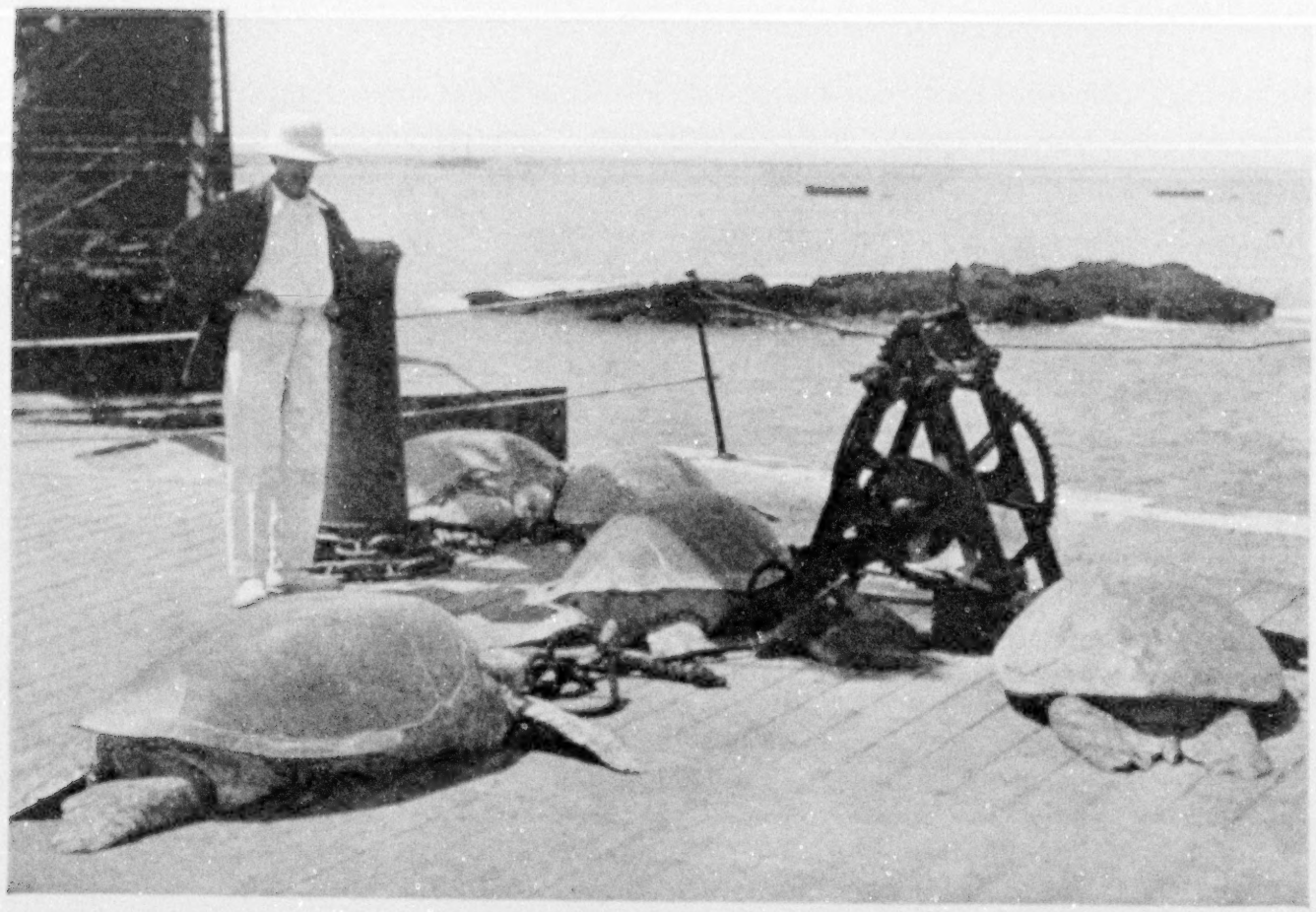
We sailed in to the anchorage of this island on a beautiful March day and signaled ashore for permission to present our credentials, as no one is permitted to land here without a score of permits. Well might they protect passers-by from such a murderers' crew.

Soon the commandant and other officials came aboard, rowed by a band of murderers and exiles. Captain Vanzetti and I accompanied them ashore through the surf to the sand beach of Santo Antonio, where we found jackrabbitlike horses awaiting us.

A GALLOP ON A TROPIC ISLE

The summit which we had sighted afar was the remarkable skyward-pointing phonolite finger of Pyramid Peak, the highest point of the island, rising more than 1,000 feet above the sea. We neared the height, galloping along on our retired Brazilian chargers, and found near its foot the little convict village which we were to visit.

The ancient stone-and-mortar houses, rather Spanish in appearance, spread along the slope overlooking the sea in front and a small valley on one side, where a spring



Photograph by W. Kenneth Cuyler

A FUNNY DISH TO SET BEFORE THE KING

Green sea turtles, on the pierhead at Ascension, awaiting shipment to Britain's king, princes, and dukes, in accordance with an ancient annual custom.

Photograph by Geo. Finlay Simmons

THE HANGING GARDENS OF ASCENSION

Vegetable gardens on the now fertile slopes of Green Mountain stand in sharp contrast to—and twenty-five hundred feet above—the red desert plains. They furnish natural antiscorbutics to the men of the mid-ocean cable station (see text, page 53).

Photograph by Geo. Finlay Simmons

A SEA FOWL'S ISLE IN A DISTANT SEA

Boatswain-bird Islet, guano-whitened and hundreds of feet high, stands in front of Ascension's iron-bound coast and serves rare sea birds as a fortress home. In crannies of its ragged cliffs, facing the turbulent sea, the red-billed and the yellow-billed bo'sun or tropic birds hide their mottled eggs.

furnished a fair quantity of brackish water for prisoners and for the rougher use of the officials, the latter depending largely on rainwater and fresh coconut-milk for drinking purposes.

We were entertained at the governor's house, where we ate many fine Brazilian dishes, including breadfruit and native vegetables. In the trees and bushes of the governor's garden we could hear the voices of three rare birds found only on the island: the cooing of an eared dove, the whistle of a unique flycatcher, and the merry songs of a vireo.

I spent several days with the governor, studying the life of the prisoners and looking over the island records. At the time of our visit about 350 murderers and 150 exiles were serving time, guarded by 50 soldiers.

We split our scientific forces into several parties. Cuyler and his bird skinners went ashore and camped in an old warehouse building behind the landing beach of Santo Antonio. They combed the island on foot and with the loan of several of the little jackrabbit horses, taking fine collections of the birds and searching for additions to the island lists. Another group of us scrambled along the rocks, seeking sponges and seaweeds, crabs and lobsters of many colors and sizes, sea urchins and anemones, and kelp fishes and their associates in the tide pools among the rocks.

SHAVED BY A CUTTHROAT

At times those left on shipboard were cut off from shore for several days. Great rollers came in from down the wind and

Photograph by A. E. Young

AN OUTLINE OF EMBRYOLOGY

Cuyler and Long John marvel at the myriad eggs carried beneath the immense shield of the green sea turtle (see pages 44 and 59). Leathery shells covered 263 fully formed eggs, and of globular yolks, large and small, there were 586 in this female.

beat on the leeward side of the island, roaring on the beaches, where they were whipped into spray by the trade winds from the southeast, pounding on cliffs and bursting high above the sea.

On such days the ship rolled and pitched and bucked at her anchors; but we were all used to the motion by then and went on with such work as could be done on the single deck.

On one of my visits to the home of the governor I had stayed overnight unexpectedly, largely because my command of the Portuguese language was insufficient for me to refuse gracefully. On arising the next morning I found the commandant in the midst of a shave, and bending over him was a thin, intelligent-looking Brazilian, who finished his job with neatness and dispatch.

KIDNAPPERS AND RAIDERS

The smooth-faced commandant waved me into the chair, as he explained that the

Photograph by W. Kenneth Cuyler

THE HOME OF A UNIQUE SEA ROVER

On top of Boatswain-bird Islet, off Ascension Island, lives a species of buccaneer bird, or man-of-war, both male and female being entirely black (see page 51), without the white markings found in the more common species in other parts of the world (see page 45).

Photograph by Geo. Finlay Simmons

THE HYDRO-SEDAN OF A PRISON ISLAND

The governor's "super-six" (with half a dozen assassins and exiles) carries him over the edge of the purling sea at Fernando Noronha and lands him dry-shod on the deck of an offshore raft (see illustration, page 66).

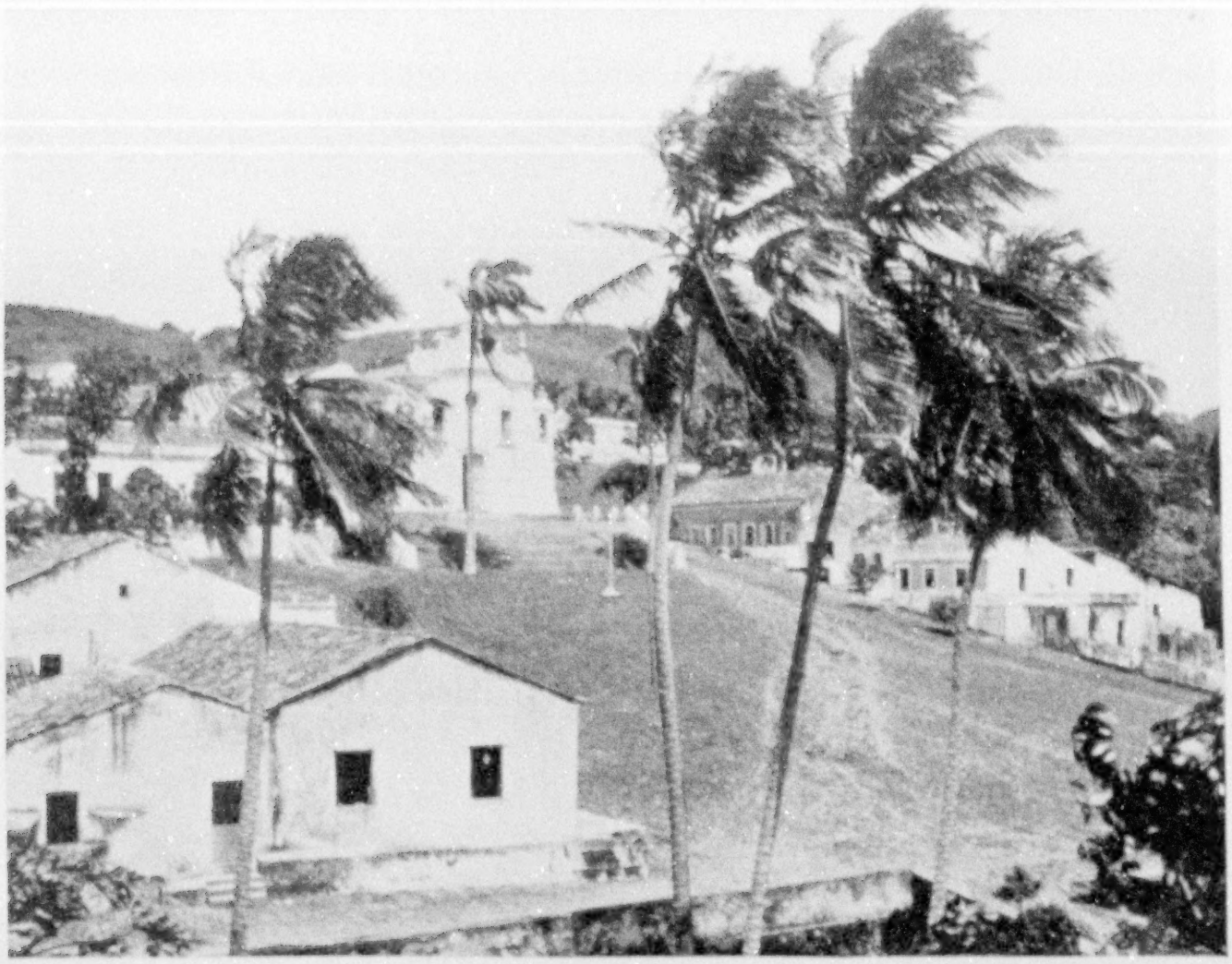
THE ROAR OF THE SURF AT MURDERERS' ISLAND

The whaleboat awaiting the lull which follows each series of several pounding rollers on the beach at Fernando Noronha. The southeast trade winds come over the island and whip the tops off the breakers rolling against them.

Photographs by Geo. Finlay Simmons

A RIDE ON A BRAZILIAN "JANGADA"

A platform raised above a raft keeps passengers and cargo dry, as they slide through the breaking surf and onto the beach of Brazil's Island of Murderers, where there are no wharves, quays, or piers.



Photograph by W. Kenneth Cuyler

WHERE BRAZIL'S LIFETAKERS LIVE, FAR FROM SCENES OF STRIFE

These buildings of the prison settlement on Fernando Noronha were mostly reconstructed 150 years ago. Besides assassins and exiles, who spend here their decades of penance, only officials and soldiers come to the island, since visitors are rarely permitted. Brazil has no capital punishment or life imprisonment for murder; the maximum sentence is 30 years in this penal colony (see text, page 60).

barber was serving a long term for murder; and he continued, as my face was lathered and I sat in considerable trepidation under the swing of the razor, by discussing the barber's crime with that busy individual.

Fernando Noronha, like all of these distant oceanic islands which we had visited, has had a long and thrilling history—defended and captured by Portuguese, Dutch, and French, and now in the hands of the Brazilians, its off-lying islet of Rat once inhabited by kidnappers and now inhabited only by birds and an occasional wild cat which pursues the peculiar lizards of the archipelago.

A FIGHT WITH A GIANT RAY

On one of our voyages around the island and while exploring its islets for rare sea birds, we sailed close to a giant ray as it swam slowly along the surface, occasionally flipping its spreading wing tips above the water. In spite of the fact that there were only three of us in the boat, we decided to have a try for this specimen, since few had ever been captured off the Brazilian coast and this might prove to be new.

We circled and, under full sail, sped down upon the monster sea vampire. John sat in the stern of the whaleboat, with tiller and sheet; Brito stood by the mast to lower away the sails at the proper signal, and I took the bow, bracing myself with a great lily-iron harpoon ready to strike. John brought the tiller in line with my signal, and as we sailed over the monster I drove the harpoon deep into the creature, as it started to dive (page 72).

We cleared for action, fought the ray as it towed the big boat along at a rapid pace, and eventually came close enough to

Photograph by W. Kenneth Cuyler

AN ALBACORE FOR DINNER

Norberto Flores returns from an offshore fishing trip on a tiny raft-boat. When officially garbed, he is the keeper of the lighthouse on Kidnap Islet, north of Fernando Noronha.

make fast another iron. Even after we had dispatched the struggling fish we had a difficult task ahead, for wind and tide were against us and we had drifted far out from shore.

The ray was too large to take aboard the whaleboat, so we brought it alongside and tried to sail back to the *Blossom*. We put out the oars and pulled away, and after six hours made the ship.

ALMOST A MUTINY

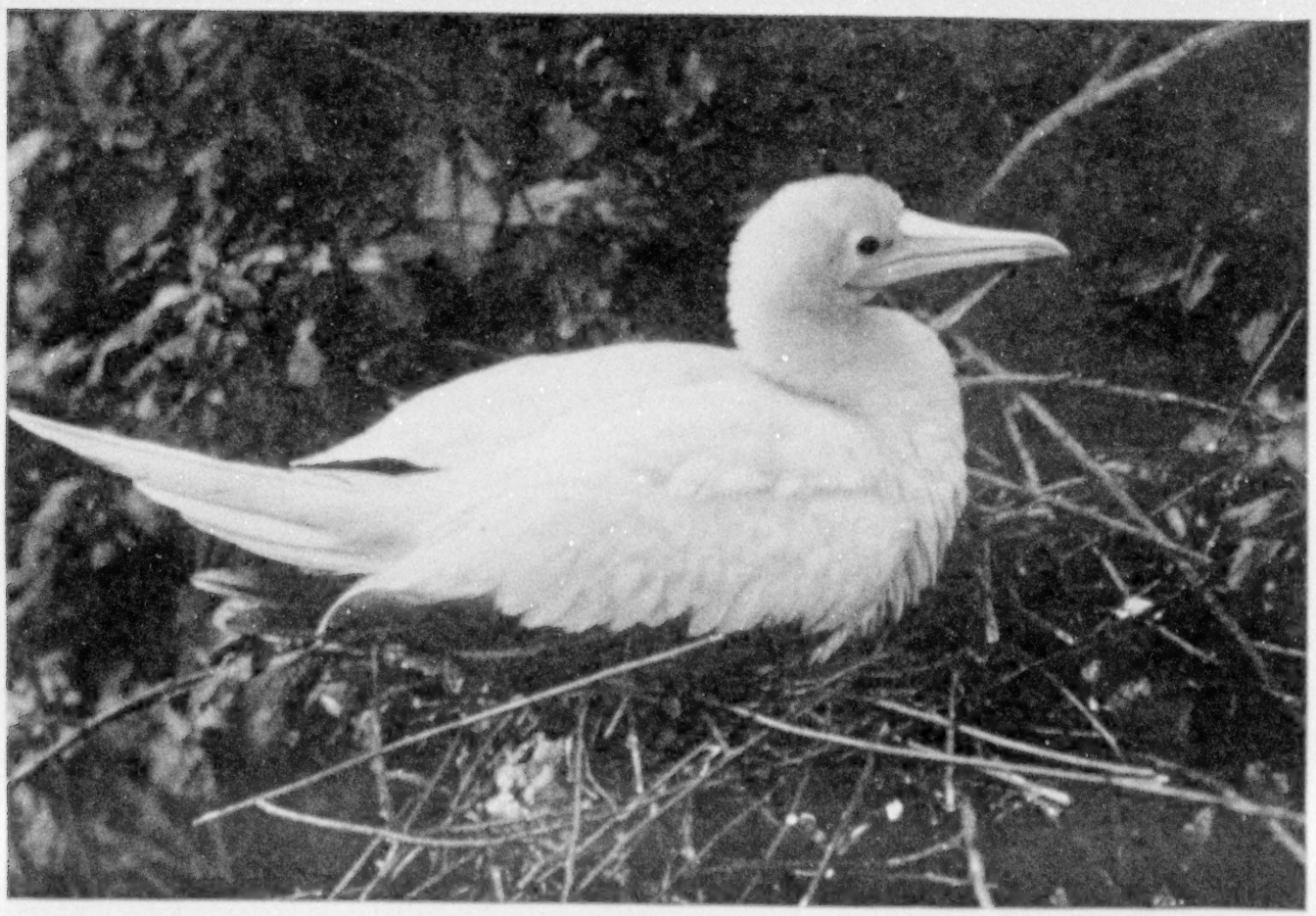
Our water supply ran low while we were at Fernando Noronha. Even under constant warning, some of the men had wasted small amounts, believing it possible to get fresh water at the island. But the island supply, too, was running short; and we could have obtained only a small quantity of brackish water by carrying it for several miles in small barrels and then bringing it through a bad surf. Fortunately the rainy season came upon us. Above the little schooner we hung awnings of all kinds, guttering the deluge into a hose and then leading it to our casks in the hold. In this way we filled enough casks to give us a margin of safety.

Food also was running short, due to unanticipated prolongation of our work, and this was more serious still.

Nine months since we left Rio de Janeiro. Eventually comes a day when the men are useless until they can get a rest ashore. Especially true is this when they have been working long hours with a certain monotony of food, far from the haunts which they love. We had enough flour and salt meats to last us for months; but we were running short of sugar, tinned butter, and other items allowed by present-day navigation laws.

THIS STUPID BIRD STARES YOU STRAIGHT IN THE FACE

A brown booby on its nest atop St. Michael's Mount, at Fernando Noronha, far above the pounding surf into which it dives for big-eyed scad and sardine.



Photographs by W. Kenneth Cuyler

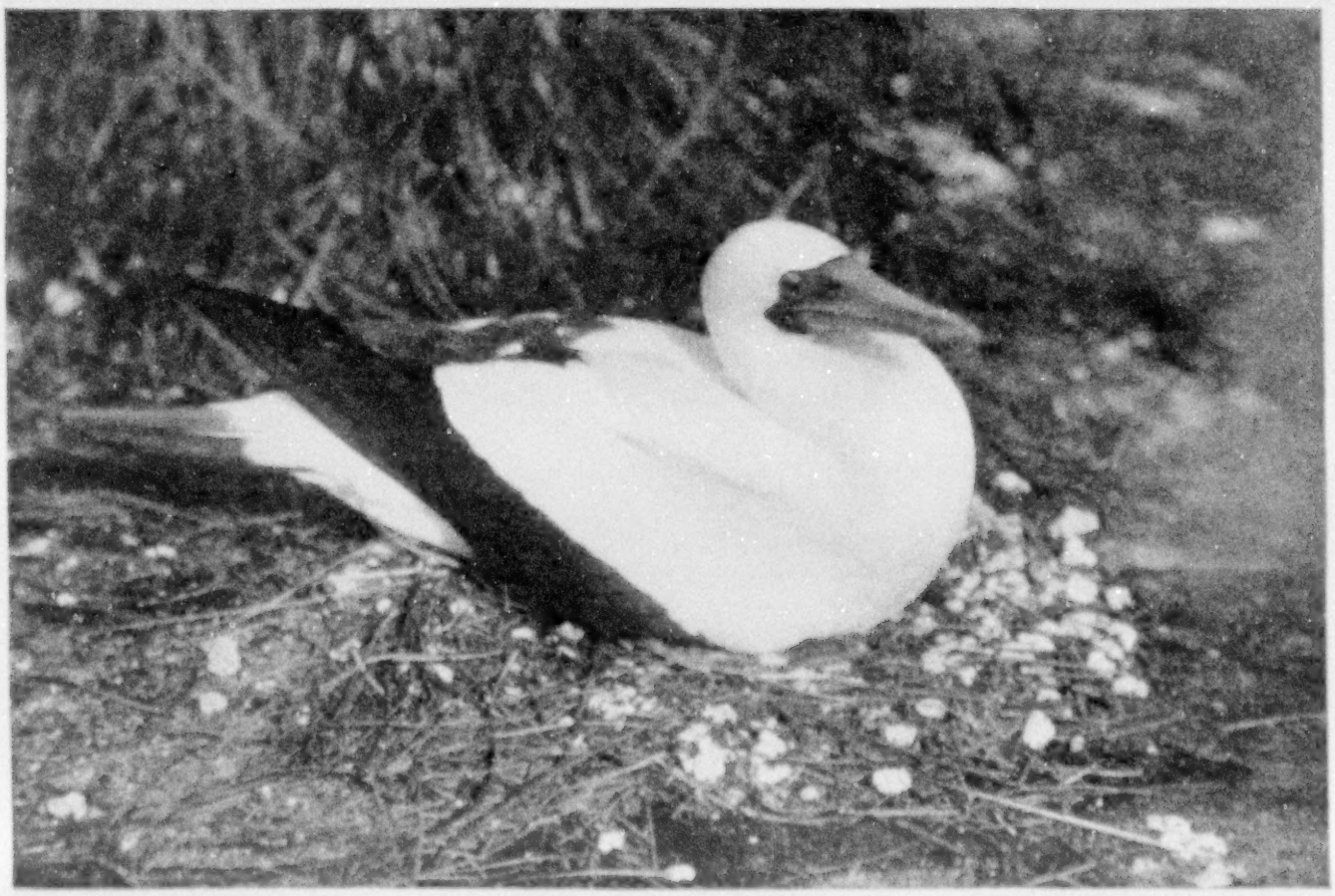
A BEAUTIFUL FISHER OF THE TROPICS

The red-footed booby of Fernando Noronha is an offshore fisherman who rarely plugs into the toppling breaker, as does its brown cousin (see above).

Photograph by W. Kenneth Cuyler

NATURALISTS DISAGREE ABOUT THIS FERNANDO NORONHA NESTER

Some believe that this bird is a form of the red-footed booby, which has a white body; but others say it's a good species, distinguished by its clear gray body.



Photograph by Geo. Finlay Simmons

THE BLUE-FACED BOOBY BROODS OVER THE FUTURE

William took one look at the birds and returned to the waiting whaleboat at Rocas Reef, saying that all the noise made him "crazy"; but Netto sucked this booby's egg and lay sick on the beach of Dead Man's Cay for an hour.

Photograph by Geo. Finlay Simmons

STUDYING CITIES OF THE UNDERWORLD

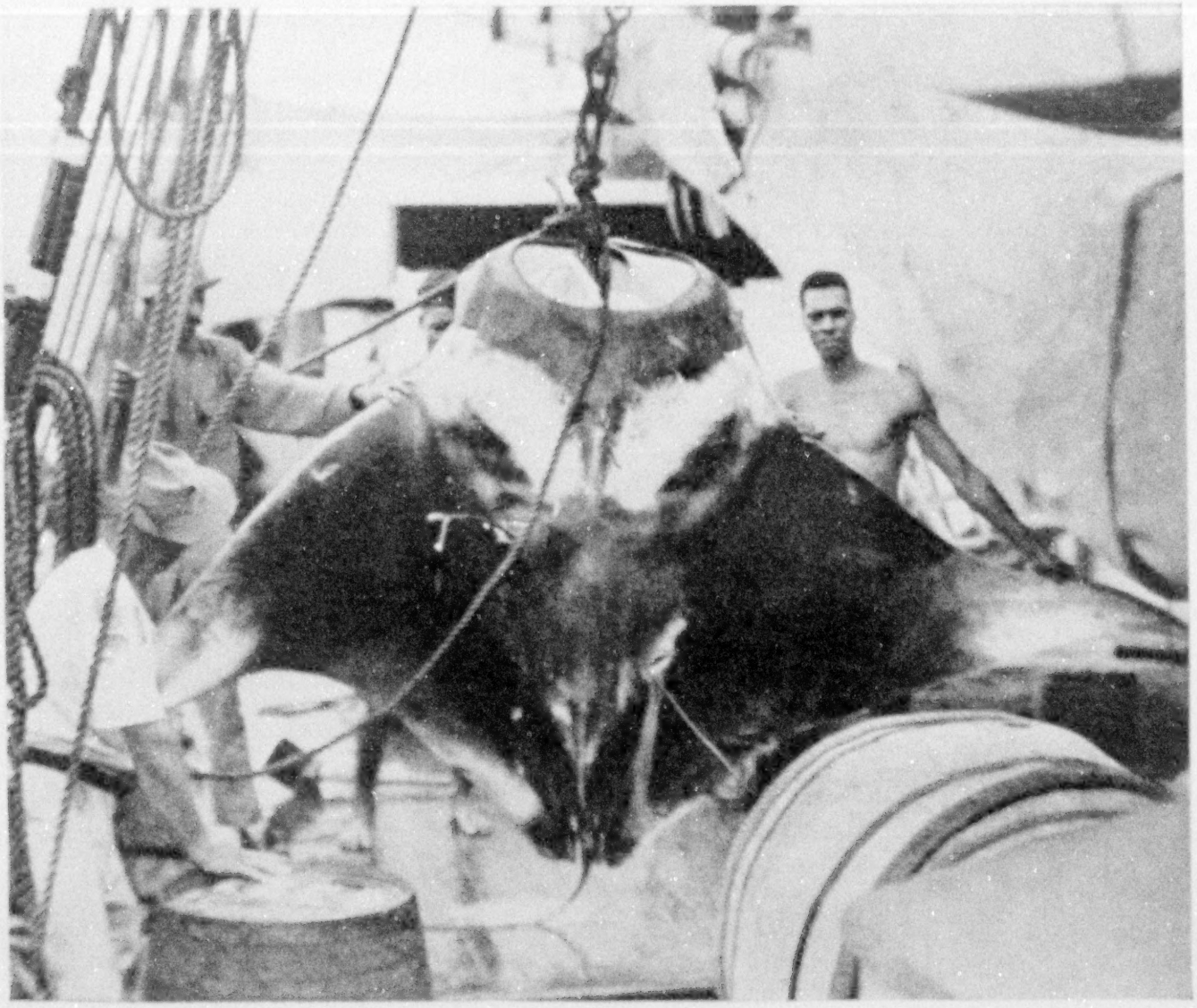
Reefs of lava and coral at low tide reveal many interesting communities along the shores of Fernando Noronha Island. Vanzetti snares a blue surgeon fish after four days of untiring effort.

The glamour of sea-roving was wearing pretty thin and the crew feared days in the doldrums and a slow passage back to the States. The sea lawyers among the crew got together and demanded that I put the ship in to Brazil and secure supplies at the port of Pernambuco; this I refused to do, knowing we would lose much time circling part of the South Atlantic to make it north around Brazil.

The commandant at Fernando Noronha permitted us to carry pigs and goats aboard alive, and the addition of a few chickens turned the *Blossom's* deck into an impromptu barnyard; but it was a necessary step in order to have some fresh food on the long passage home, for we had no refrigerating machinery and our tinned foods were continually spoiling in rusting cans in the hold.

ON ROCAS, SHIPWRECK REEF

With the addition of a small quantity of fresh vegetables purchased from the island storekeeper, we set sail one evening and moved westward in a heavy rain squall. Night and the rain soon hid the island from us.



Photograph from Geo. Finlay Simmons

THE VAMPIRE OF THE SEAS

This giant ray was harpooned by three men in a whaleboat off Fernando Noronha, the author wielding the iron, with Long John at the tiller and Brito at the sails. After six strenuous hours the monster was hoisted aboard the *Blossom* (see text, page 67).

The next day at noon we were alongside a pair of most interesting islets surrounded by a savage offshore reef.

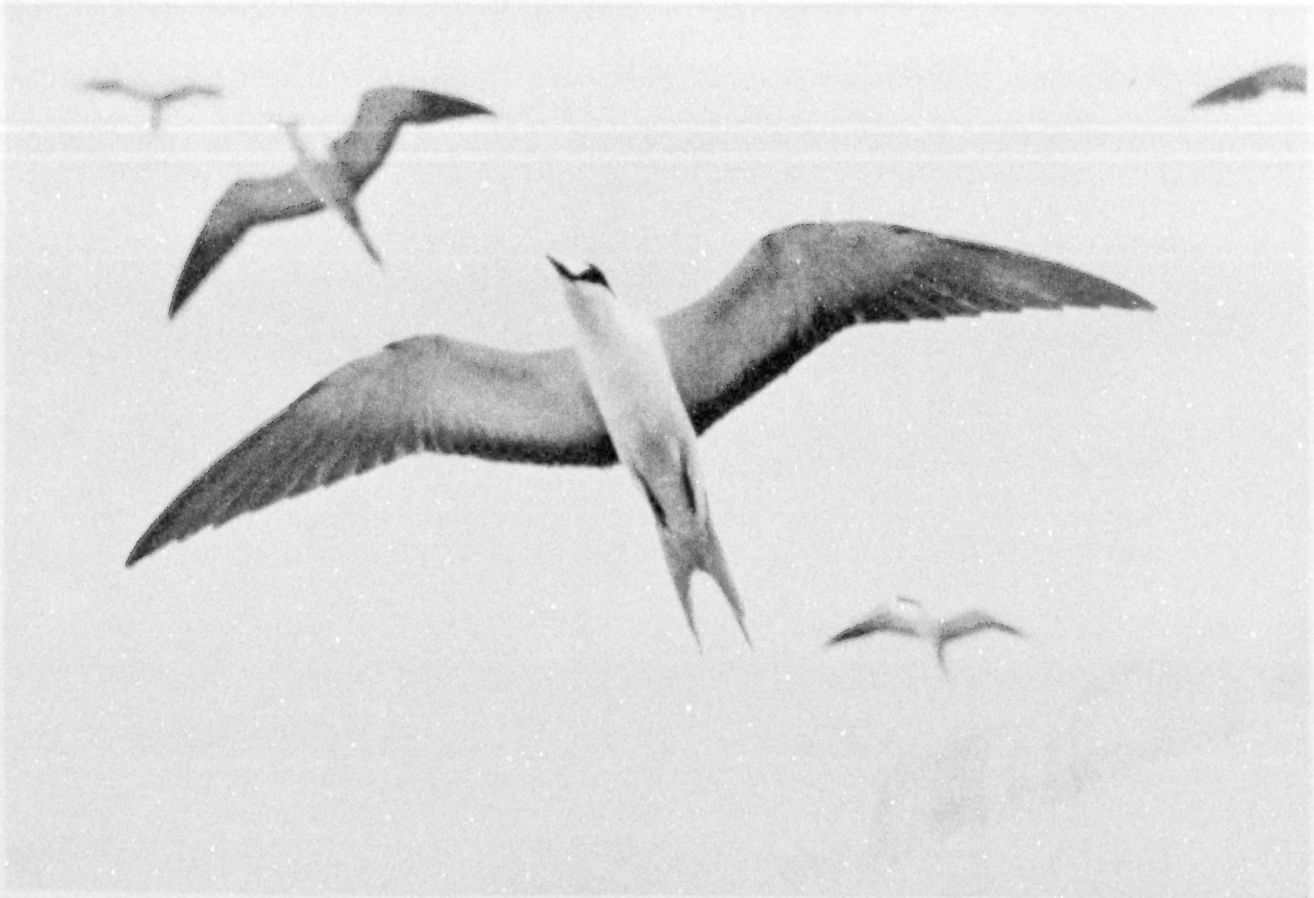
With the seas running high, the schooner stood off about six miles from the dangerous, nearly circular, coral reef of Rocas. As we approached we were sadly disappointed, for there seemed to be but few birds. Sailing along in the whaleboat, we had seen a few Mother Carey's chickens, both the short-legged Leach's and the long-legged Wilson's species; they had circled swiftly about the whaleboat and danced astern upon the waves.

The sea was up, pounding and roaring over the reef as we edged along, looking for an opening through which to run in to the lagoon. The reef, encircling and protecting two sand cays, is nearly circular, about five and a half miles in diameter east and west and four miles north and south.

We finally lowered sail and, by hard pulling at the oars, made it through an opening and beached the boat on the lagoon shore against New Moon Cay, which bears the ruins of an old refuge house of masonry, with the fragments of a couple of low outhouses behind it, a tall coconut palm, a lookout masthead, and an automatic light atop a thin iron skeleton derrick.

At once a cloud of wings arose in the air, and we realized that the ground had been covered with birds sitting on their eggs. Most of them were sooty terns; but we estimated that there were 1,500 nests of the blue-faced booby, 1,200 of the brown noddy, and perhaps a few nests of other birds, for we saw about 350 brown boobies, 25 red-footed boobies, and 15 man-of-war birds.

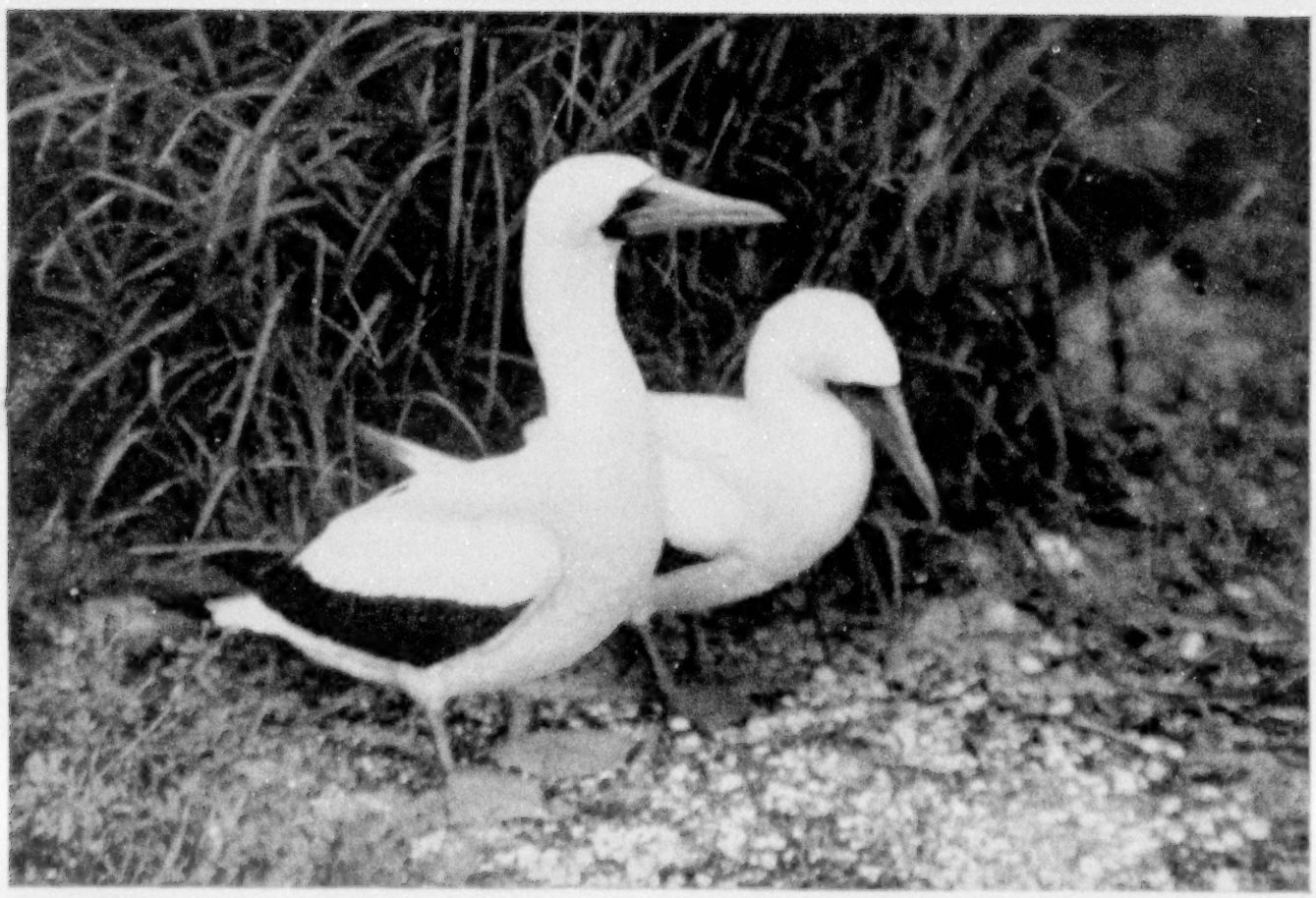
We also found large numbers of birds



Photograph by W. Kenneth Cuyler

WIDE-AWAKES ON THE WING

Ten thousand dozen edible eggs of the wide-awake, or sooty tern, may be taken each week on Ascension Island during the nesting season, which for some reason begins several months earlier each year (see, also, page 54). Instead of once a year, the bird breeds four times in three years.



Photograph by Geo. Finlay Simmons

A PAIR OF "BOOBS" ON DEAD MAN'S CAY

The blue-faced boobies of Rocas Reef were just as dumb and stupid as those which the collectors met at Ascension Island and on Fernando Noronha.

Photograph by Geo. Finlay Simmons

BEDLAM ON THE BEACH OF NEW MOON CAY

Hundreds of thousands of wide-awakes, noddies, and blue-faced boobies, with a few red-footed and brown boobies and the man-of-war, fill the air above this crossroads of the sea at Rocas Reef, near the northeastern corner of Brazil.

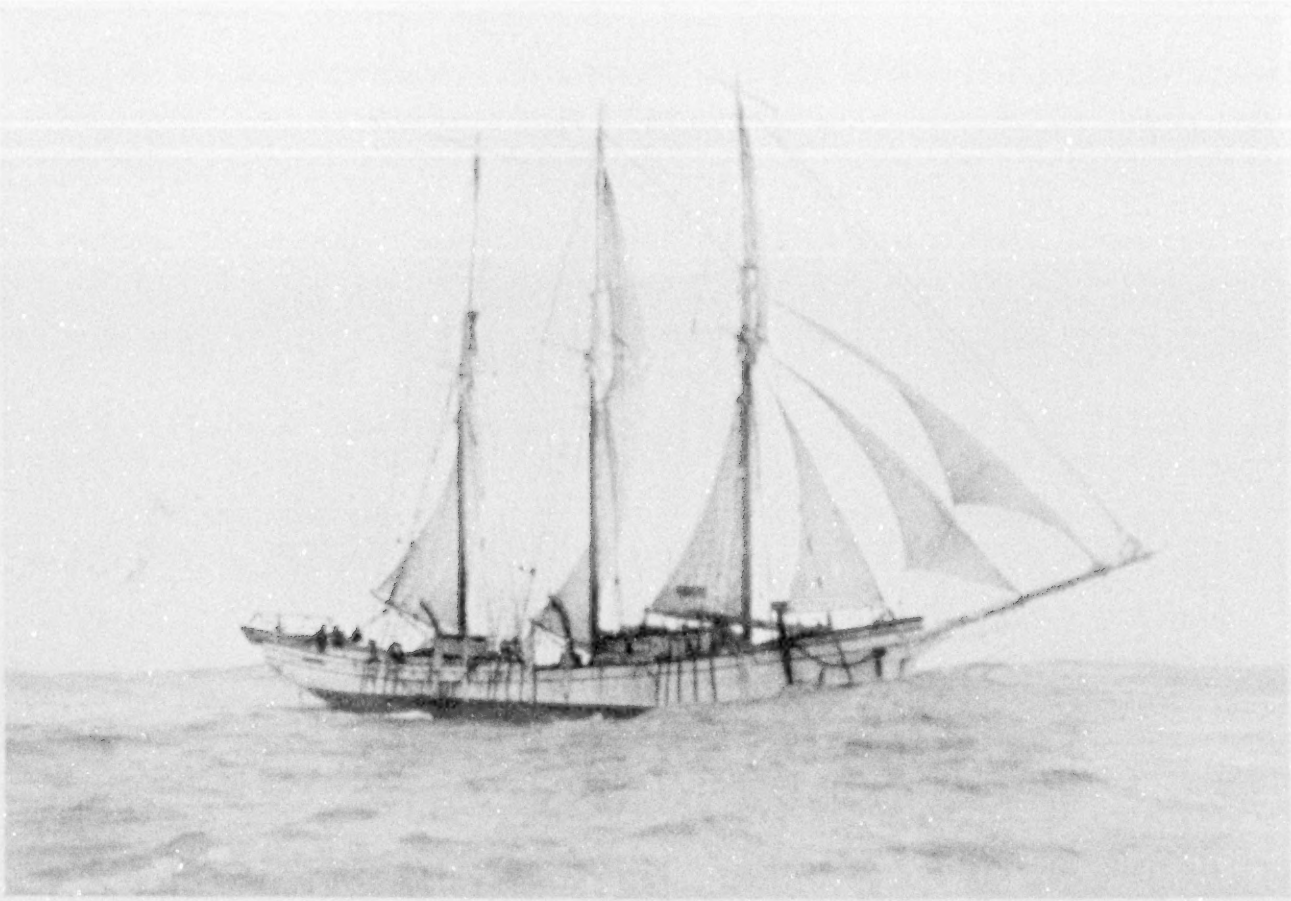
on adjacent Dead Man's Cay. At one spot we saw several low mounds, and over one of them stood a small wooden cross, stuck in the guano and sand, bearing a Portuguese name.

SKIRTING THE WEST INDIES

We found tracks, bones, and the newly hatched young of the green turtle on New Moon Cay. Crabs of different kinds were about, and in the waters we observed many brilliantly colored fishes, a score of species playing about in the shelter of the lagoon. Sunset was coming on and the *Blossom* had already drifted many miles away on the horizon; so we pushed out, hoisted sail, and started on a long race down the wind, which put us aboard about 9 o'clock at night.

Within 48 hours we reached the doldrums, which in early May are much farther south than in November, when we had crossed them, southward-bound, in 1924. Light squalls came to our aid, and we spent only a part of two days in crossing the narrow belt of calms. On May 6 the northeast trades began to steady down, and for 16 days we sped merrily along, never making less than 100 miles a day and twice making about 175 miles. Life on board then was an idyl of sunlit decks and smooth sailing.

Birds were few, but occasionally we saw a greater shearwater, and just north of the Equator a yellow-nosed albatross and a red-billed tropic bird were sighted. Wilson's petrels, or Mother Carey's chickens, were with us a good part of the time.



Photograph by W. Kenneth Cuyler

HOMEWARD BOUND IN HALF A GALE

Nearing the West Indies, we sighted occasional sea hens, or skuas, and yellow-billed tropic birds. The latter were doubtless the kind seen by Columbus and his men when they approached these islands.

Every few days we killed and butchered a hog and continually had fresh pork in the galley; the goats and chickens, too, disappeared one by one, until at last only our cat from Fernando Noronha was left. But the cat was safe, for we couldn't catch her. Neither could we catch an auxiliary schooner, doubtless a rumrunner, sighted here; she pulled away from us and disappeared.

HOMEWARD BOUND

We edged into the Sargasso Sea once more, this time for five days; then the breeze picked up and the *Blossom* was soon merrily running along, working upward toward the coast of the Carolinas. We began sighting steamers, and then a tugboat towing a large dredge. The water became warm, so we knew we were in the Gulf Stream, nearing home once more.

We had been unable in foreign ports to replace our stolen charts, so we neared the coast with only a North Atlantic chart, aided by Bowditch location lists and a map of Charleston found in an encyclopedia.

We sighted the South Carolina coast below Charleston, and then edged northward along the distinct line where the yellow shore water joins the blue-green of offshore depths. Proud of our little ship, we wanted to sail her in; but we knew nothing of the channel, so we signaled for a pilot. Scarcely had we slowed up for the mouth of the channel when an auxiliary pilot schooner, as large as the *Blossom*, circled near and lowered her dinghy.

We eagerly questioned the pilot for news, as we sailed up the channel and anchored at nightfall, and were cleared early the next morning. The beautiful little Southern city opened up before us; we were soon at the pier and were welcomed by relatives, friends, and the hospitable people of Charleston.

The voyage of 31 months was over; we had reached the end of our 20,000-mile trail, with nearly 13,000 natural-history specimens, many thousands of photographs, and notebooks bulging with stories of the interesting creatures of distant isles and seas.

Photograph by H. Armstrong Roberts

A SWALLOW-TAIL AT ITS BANQUET TABLE

When not flying, the butterflies usually bring their wings together over their backs. On the other hand, the moths fold the top wing over the underwing in many cases. Each shows its brightest hues when flying (see text, page 88).

STRANGE HABITS OF FAMILIAR MOTHS AND BUTTERFLIES

By William Joseph Showalter, Sc. D.

Author of "Exploring the Mysteries of Plant Life," "Exploring the Glories of the Firmament," etc., and Co-author of "The Family Tree of the Flowers" and "Familiar Grasses and Their Flowers," in the National Geographic Magazine

With Natural Color Illustrations by National Geographic Society Staff Photographers

THE order of insects made up of the butterflies and moths is one of the most fascinating of all the orders of living creatures. Its members range in size from the magnificent Swallow-tail butterflies and Cecropia moths, with wing-spreads of many inches, to the tiny leaf-mining Nepticula, measuring less than an eighth of an inch from tip to tip; in beauty, from the resplendent Peacock butterflies and Luna moths to the drab clothes-moth; in larval form, from the hairy, woolly bears and naked hickory horn devils to the grublike wood borers; in feeding habit, from the nectar-sipping Fritillaries to the aphid-eating Harvesters; in habitat, from the highest mountains and the coldest polar areas to the lowest plains and the hottest equatorial regions; and in relationship to man, from the beneficent silkworm to the destructive cutworm and the tree-destroying Gypsy moth.

BUTTERFLIES SERVE BEAUTY; SOME MOTHS WREAK HAVOC

About 9,500 species of butterflies and moths are to be found in North America. Of these only 650 are butterflies.

Only a few species of butterflies have become pests, most of them being as harmless as they are beautiful. They are a very compact, closely knit group of insects, showing their comparatively recent origin.

On the other hand, the moths disclose a remarkable diversity of appearance, habit, and habitat. Large groups of them exact a tremendous toll of field, orchard, garden, and lawn, and levy heavy tribute upon the Nation's shade and ornamental trees.

In the orchard their caterpillars attack alike blossom, foliage, fruit, wood, and root. In the garden they prey alike upon stalk and vegetable. In the field tender shoot, growing plant, and mature grain suffer at their hands. Some invade flour mills and clothes closets, others quarter themselves in ant nests and beehives. But of the thousands of species not more than 100 are pests.

A few aberrant species have wingless females and others have clear wings, linking them closely in appearance with the bees (see Color Plate X, figures 3 and 5) and the wasps. So thoroughly do some of the latter imitate the bees and the wasps, both in habits and in appearance, that man and bird alike usually give them that wide berth which is accorded the stinging tribe.

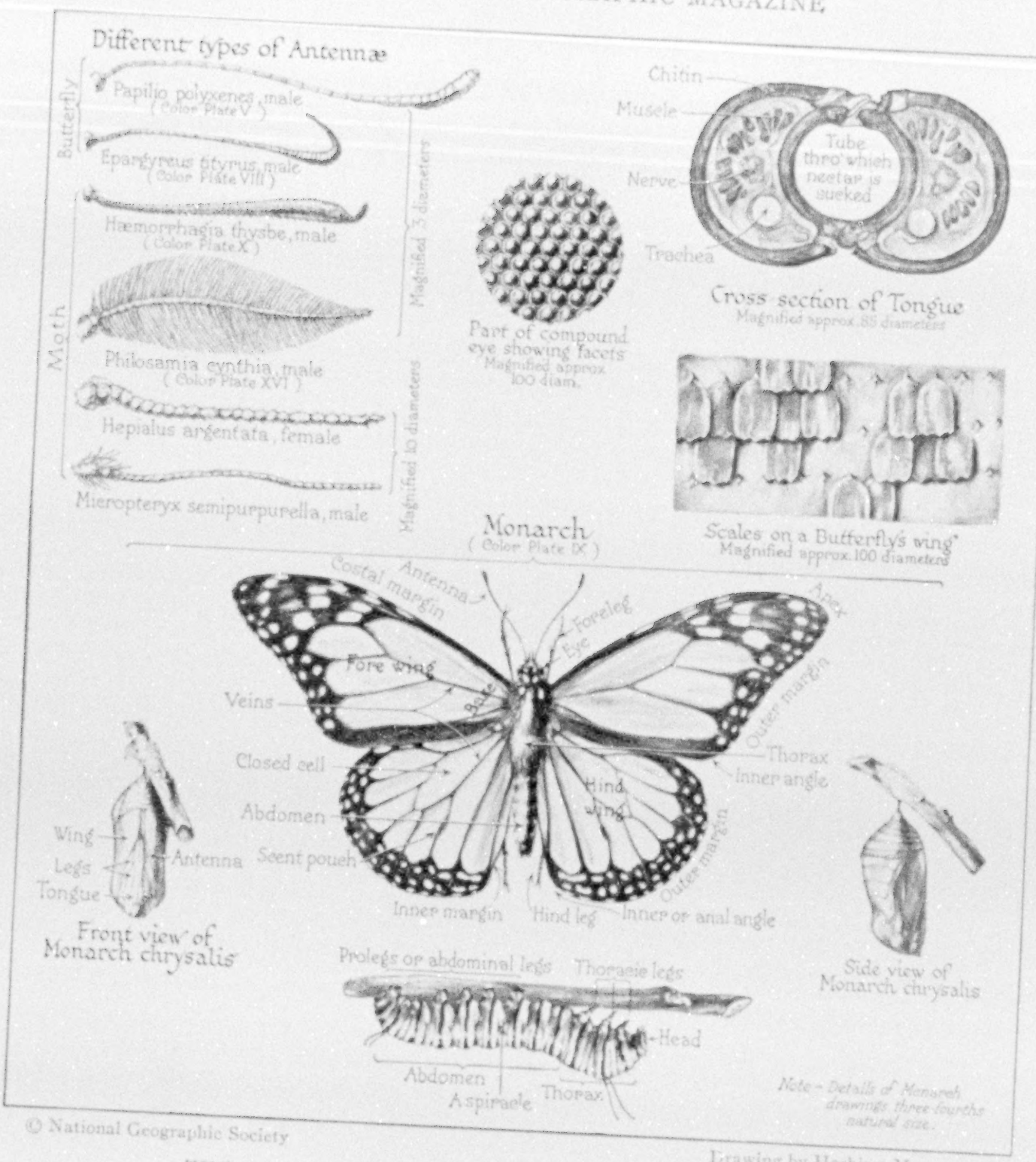
There are two small families, known as the Jugate moths, which form the "missing link" between the primitive insects and the full-panoplied moths and butterflies.

The primitive insects had two pairs of wings equal in size and function. As they have come down through the geological ages, some of them, like the bees and wasps, have thrown the flight functions on the fore pair of wings, and others, like the locusts, crickets, and beetles, have turned the task of flight over mainly to the hind pair. A third group, the Diptera, make no use whatever of their hind pair of wings; so Nature took these away entirely. The Jugate moths carry a striking reminiscence of this change. Like the caddis flies, their two pairs of wings are tied together with a jugum.

IN WHAT PARTICULARS MOTHS AND BUTTERFLIES DIFFER

There are many obvious differences between moths and butterflies.

The butterflies wear knobs on the ends of their antennæ, while the moths, with such few exceptions that the average amateur will never encounter one, lack



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Drawing by Hashime Murayama

THE ANATOMY OF A BUTTERFLY AND ITS CATERPILLAR

The details at the left in the upper half of the illustration show the different types of antennæ occurring among butterflies and moths. The greatly magnified section of a Monarch butterfly's wing (right center) shows how the scales (see also lower portion of Color Plate I) are attached to the wing surface by a sort of stem to a socket. The nodules are the sockets from which scales have been brushed away.

these knobs or possess plumed antennæ (see illustration above).

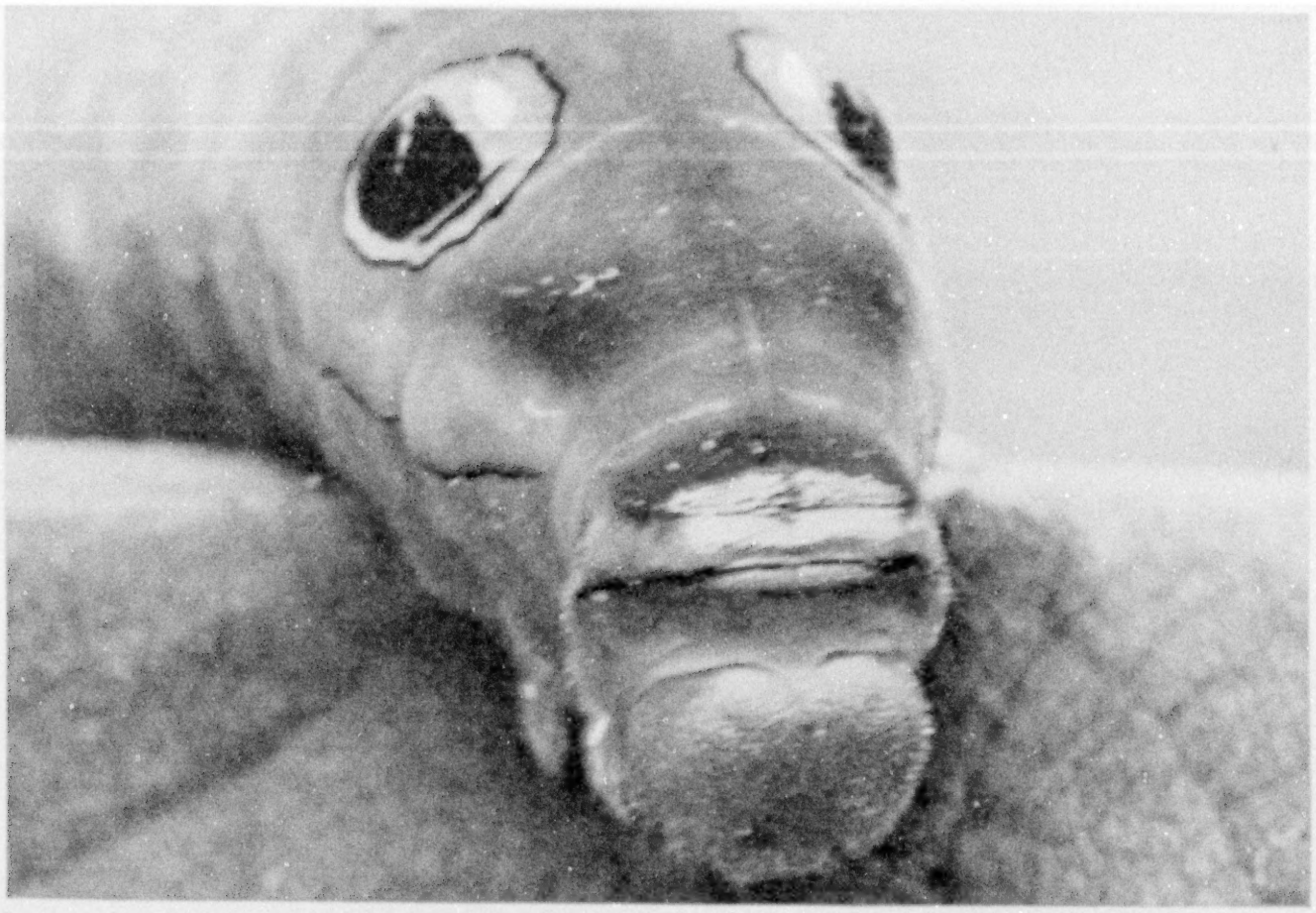
The moths make cocoons of silk, enter the ground, or make cells in wood for their nymphal naps, while the butterflies are satisfied with a sort of hardened integument, or chrysalis, the pupæ being otherwise unprotected.

Most of the butterflies are slender-bodied, while most of the moths are plump.

The butterflies are day flyers, while most of the moths prefer to take wing after the sun has passed below the horizon.

But both moths and butterflies employ marvelously the arts of camouflage to deceive their enemies.

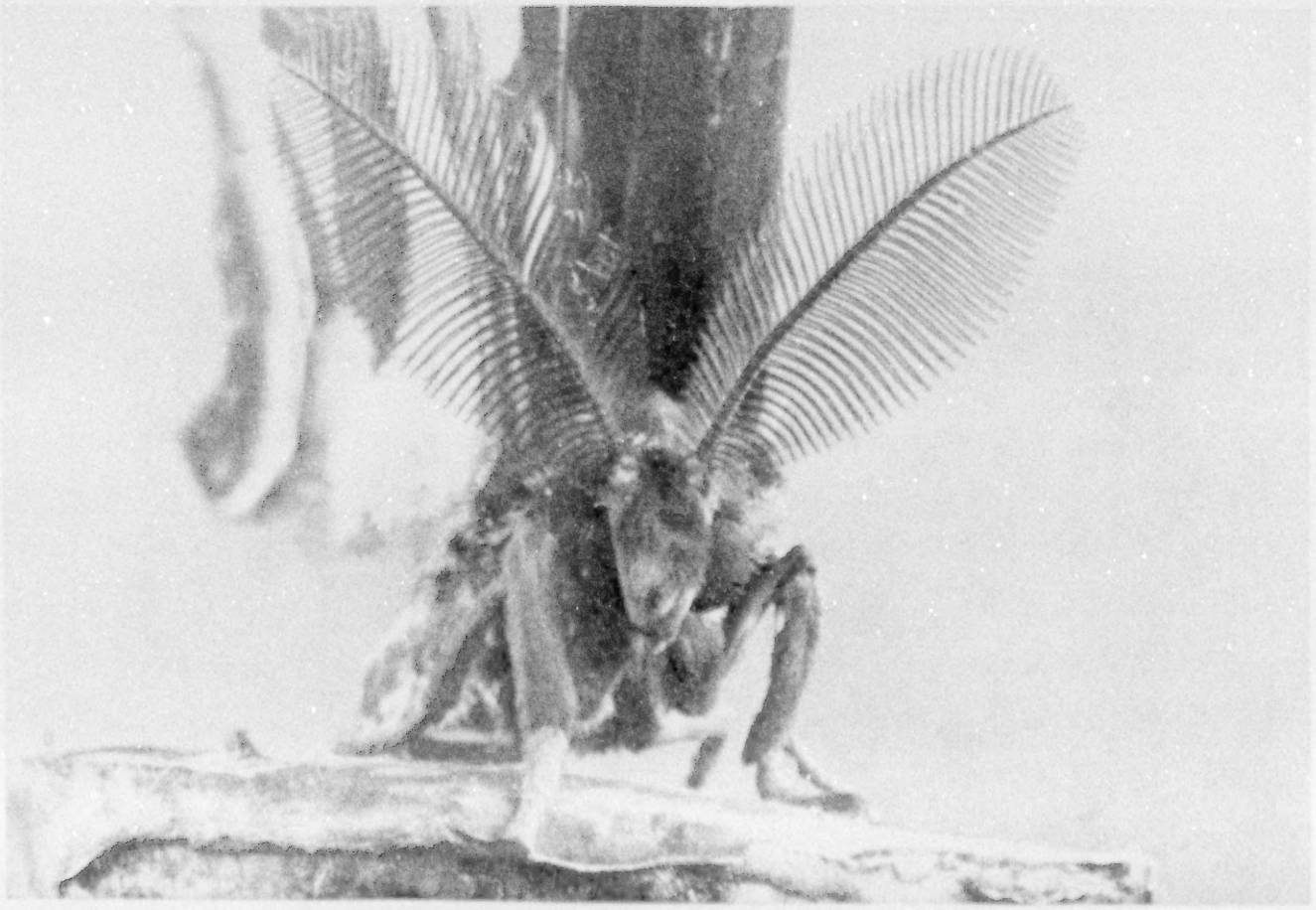
Some of them in the caterpillar stage dress up in stinging hairs that make them unattractive to birds; others possess sharp, acrid flavors that are not pleasing to a bird's palate. Many are ornamented



Photograph by David Fairchild

HOW A CATERPILLAR STRIKES TERROR TO A FOE

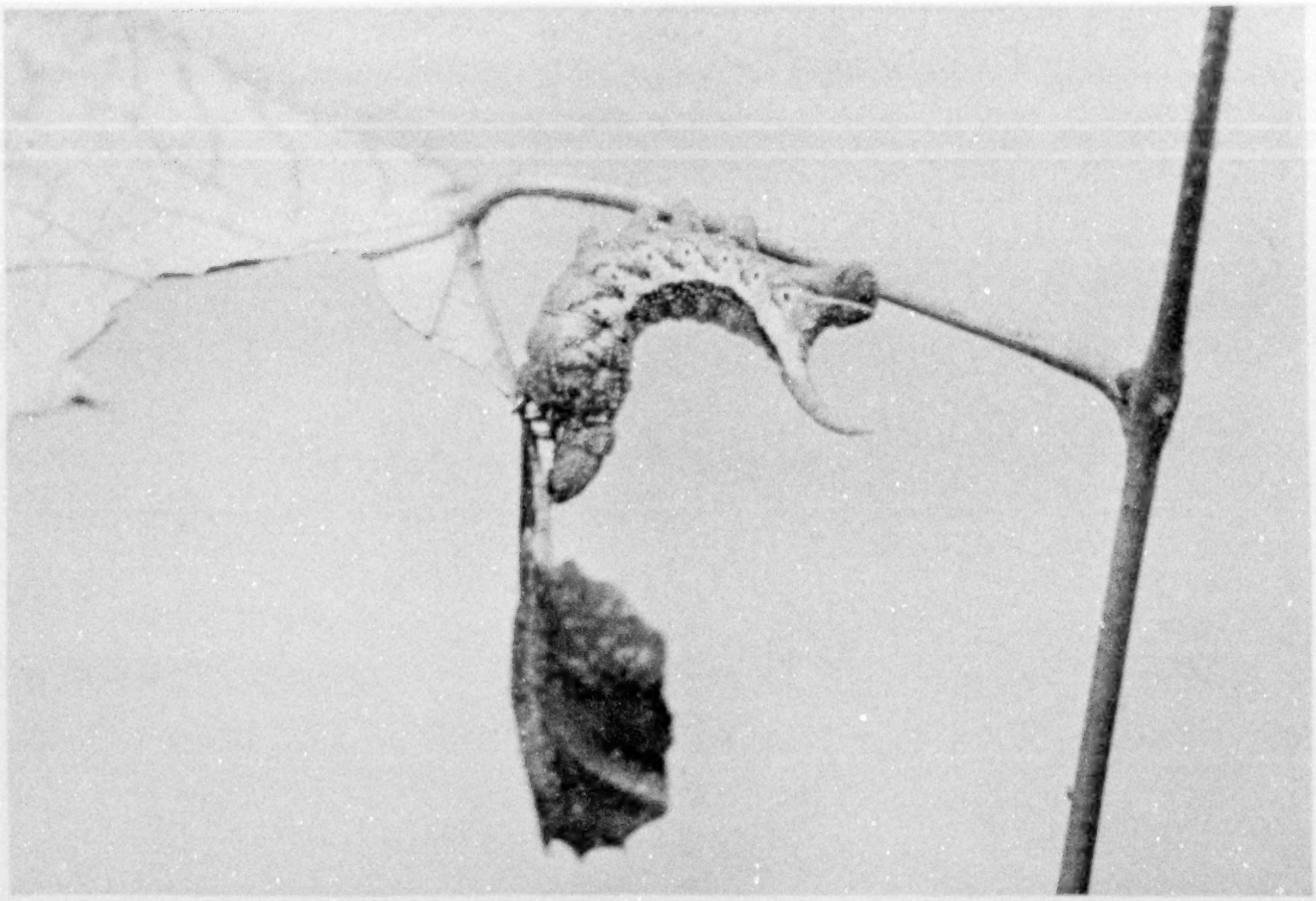
The fearsome mien of this larva of a common Swallow-tail Butterfly (greatly magnified) is only camouflage. The real head of the insect is the small semicircular segment at the bottom of the picture. The huge "eyes" are only make-believe (see text, page 91).



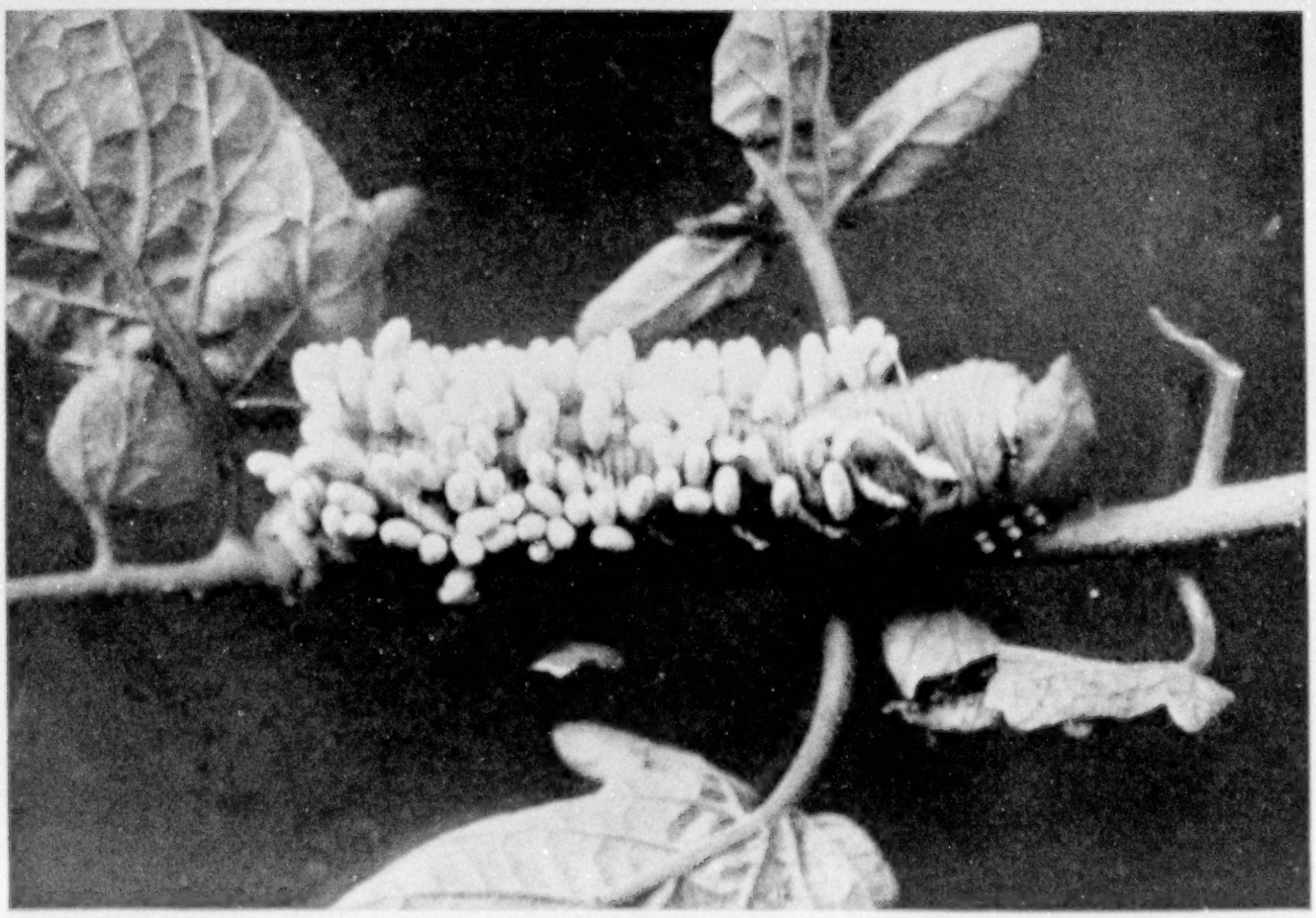
Photograph by Graham Fairchild

A JAVA COUSIN OF "SAMIA CECROPIA"

The antennæ of moths and butterflies are believed to be the aërials through which they receive the calls of their distant mates. The photograph is greatly magnified.



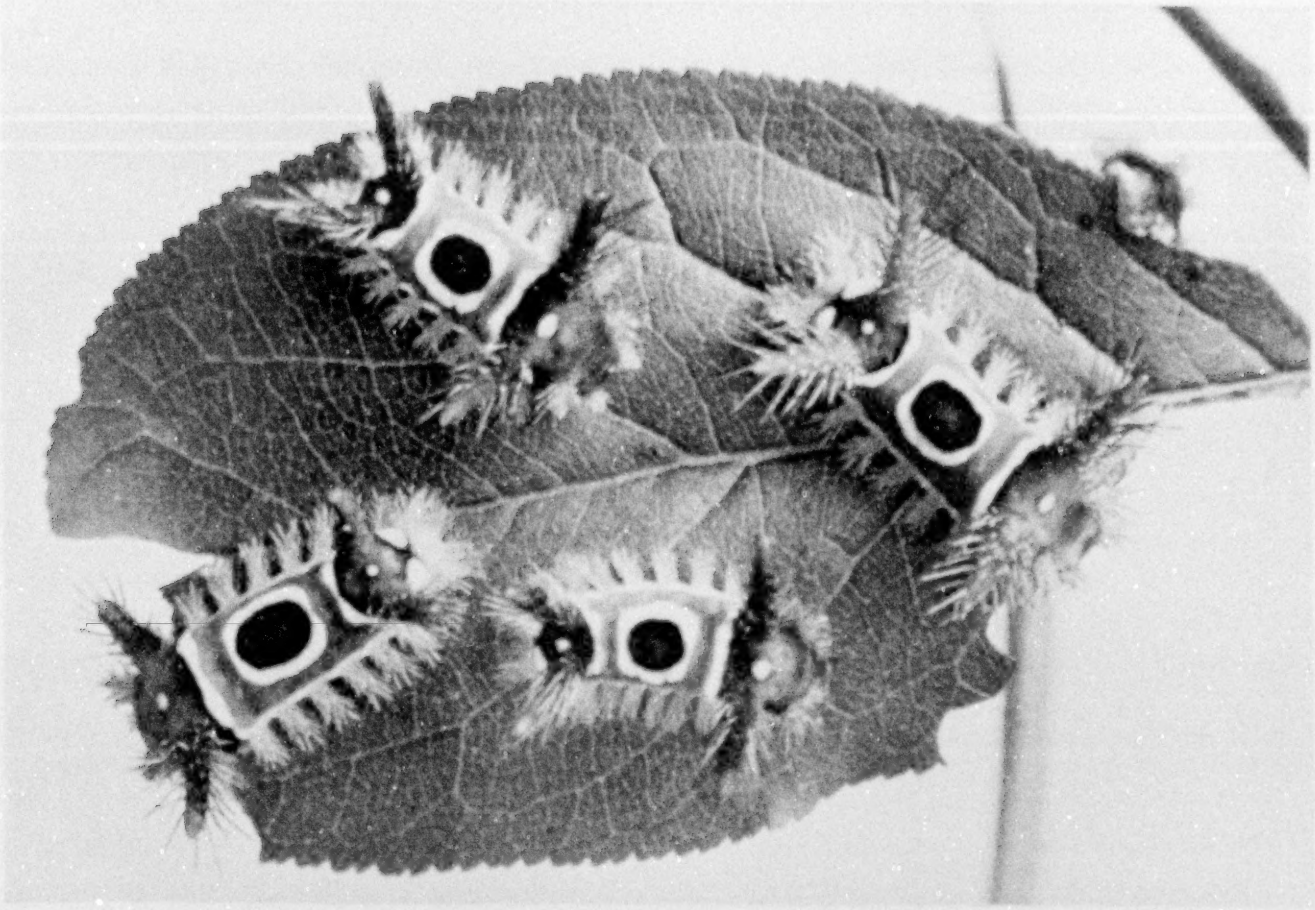
THE CATERPILLAR OF THE HOG SPHINX MOTH (SEE COLOR PLATE XI, FIGURE 8) FEEDING ON THE GRAPE



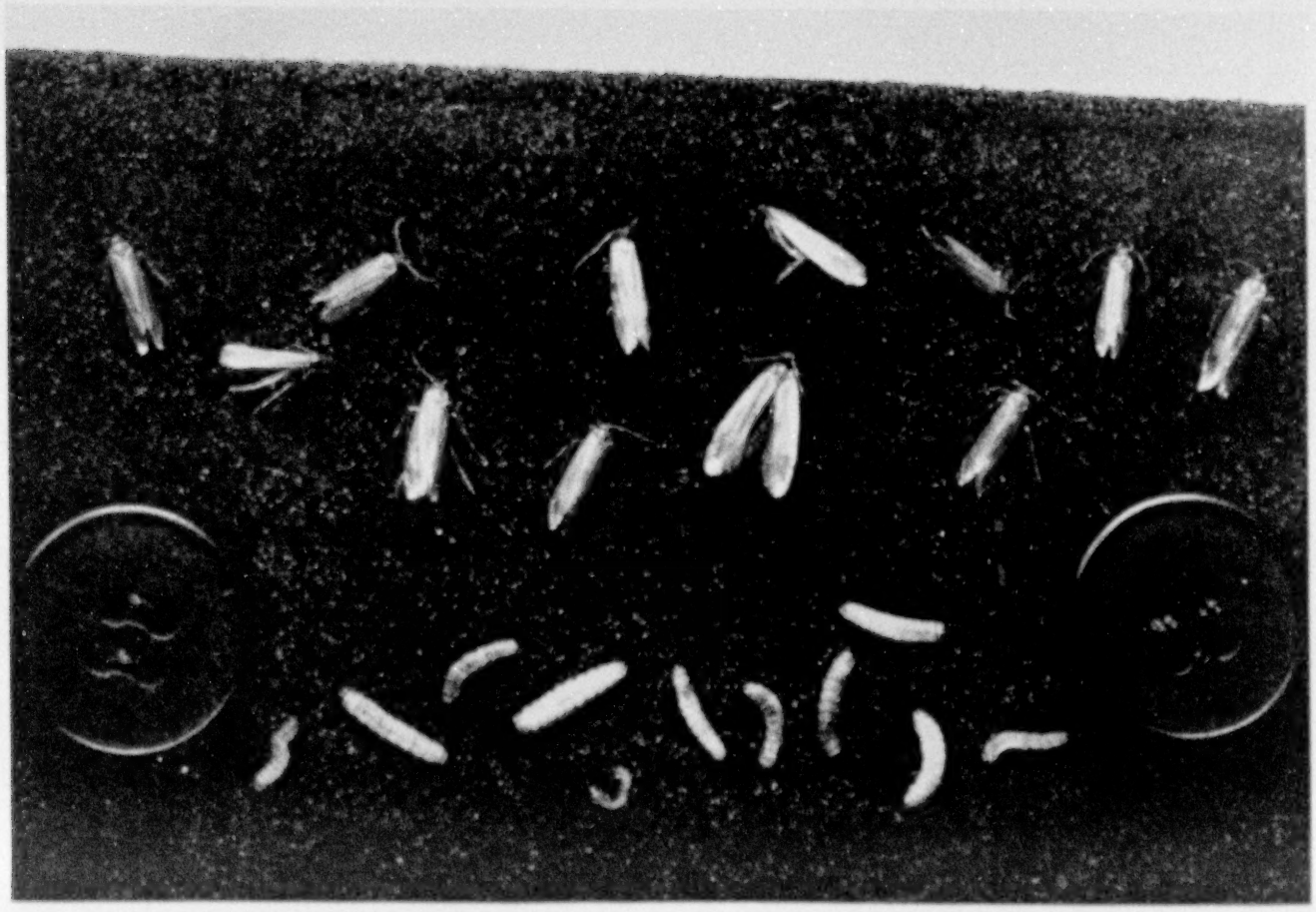
Photographs Courtesy U. S. Department of Agriculture

A TOMATO CATERPILLAR VICTIM OF PARASITISM

One of the fantastic tricks in Nature encountered in the insect world is polyembryony, wherein a single egg of a parasite may produce as many as 300 larvæ of the same sex. The scores of cocoons on this caterpillar's body are the offspring of such a prolific egg (see pp. 91-92).



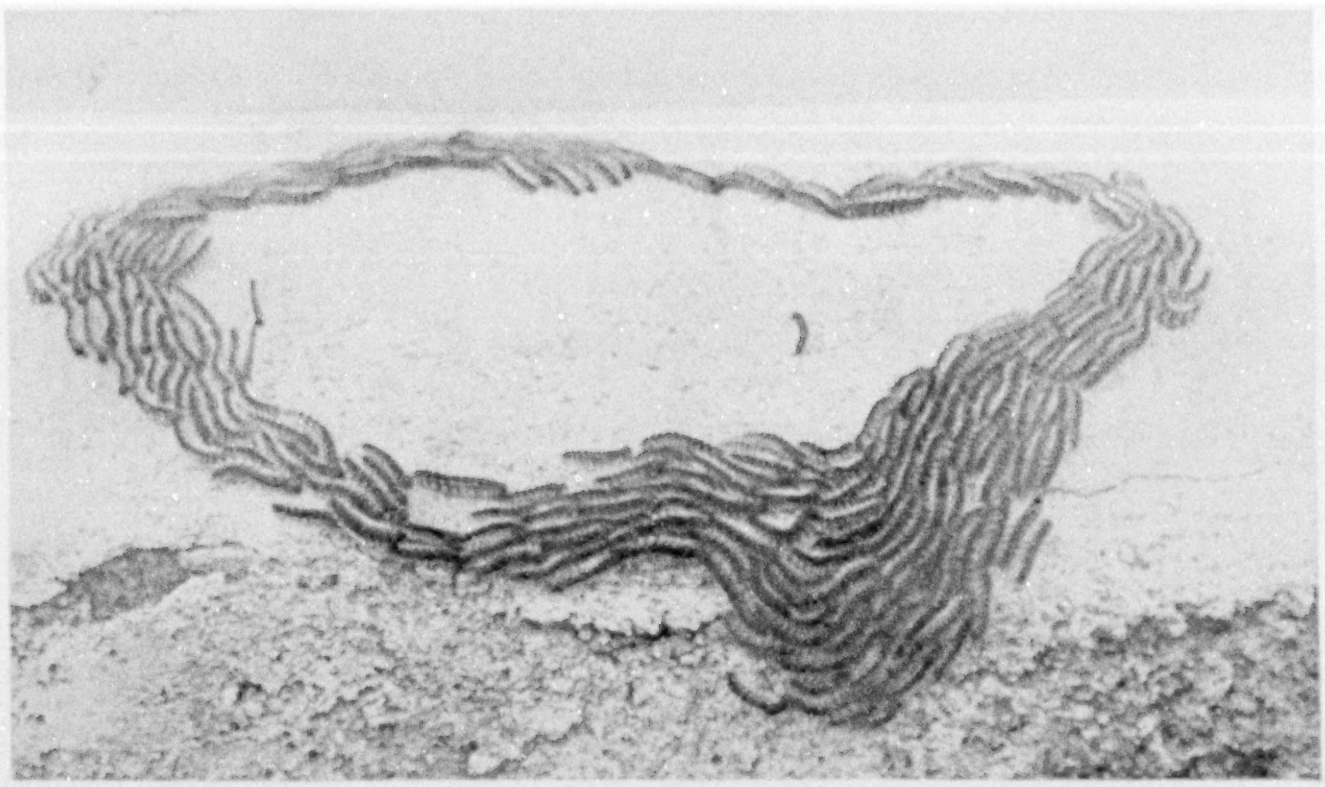
THE SADDLE-BACK CATERPILLAR OF THE SOUTH IS ESPECIALLY FOND OF GREEN CORN BLADES



Photographs Courtesy U. S. Department of Agriculture

READY TO WREAK HAVOC: WEBBING CLOTHES-MOTHS AND THEIR LARVÆ

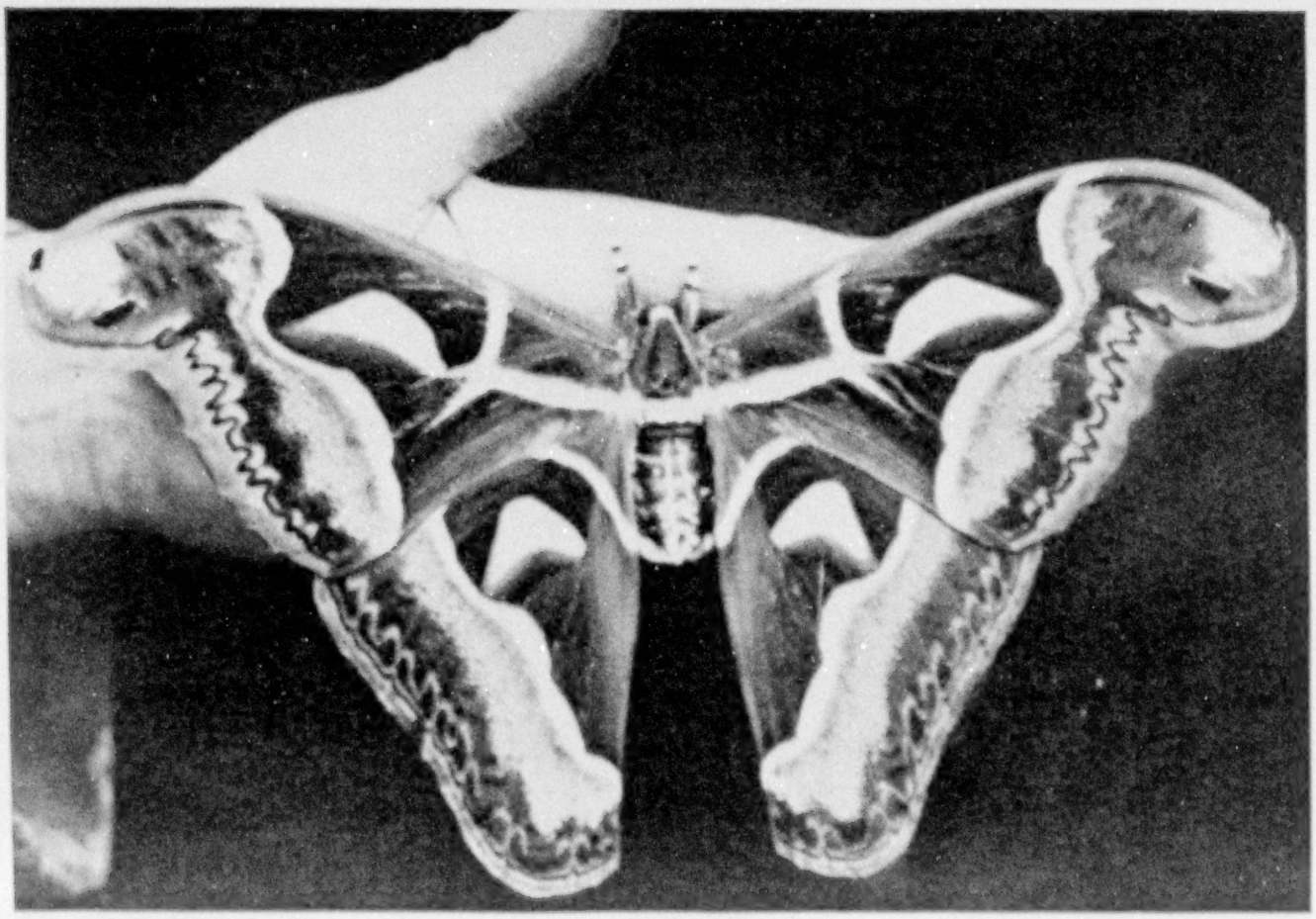
The moth itself is perfectly harmless, but the larvæ that hatch from its eggs spin themselves little transparent tubes or tunnels of silk wherever they go. They feed upon the wool fabric and also use fragments of it in making their pupal cases. These larvæ will riddle this coat.



Photograph from George Whittaker

AROUND, AND AROUND, AND AROUND MARCH THE PINE PROCESSIONARY CATERPILLARS

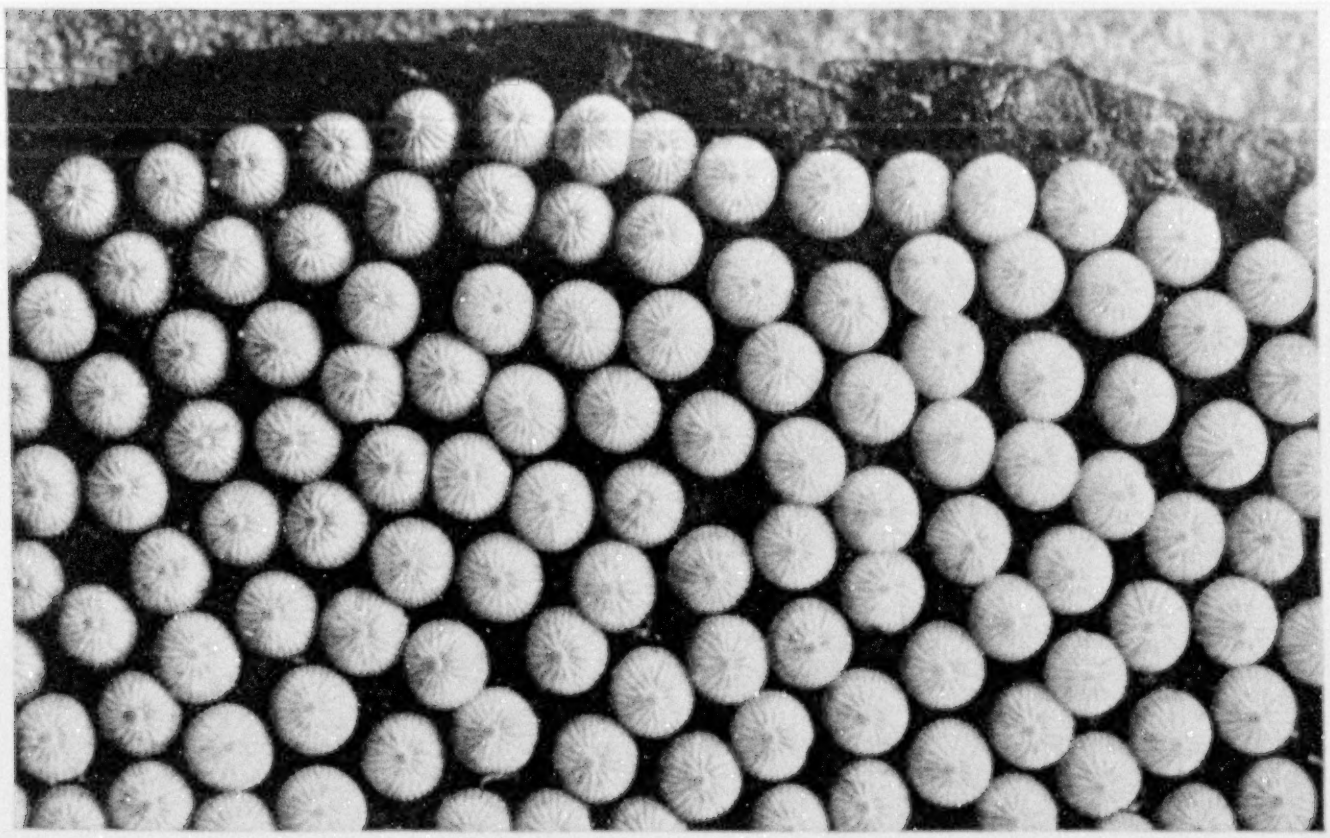
So stupid that they cannot find their way home without their guiding life line, and yet so alert to barometric changes that they make excellent prognosticators of inclement weather, these European cousins of the species that build their tents in our apple trees (see illustration, page 83) are one of the strangest contradictions in the insect world (see text, page 93).



Photograph from Acme

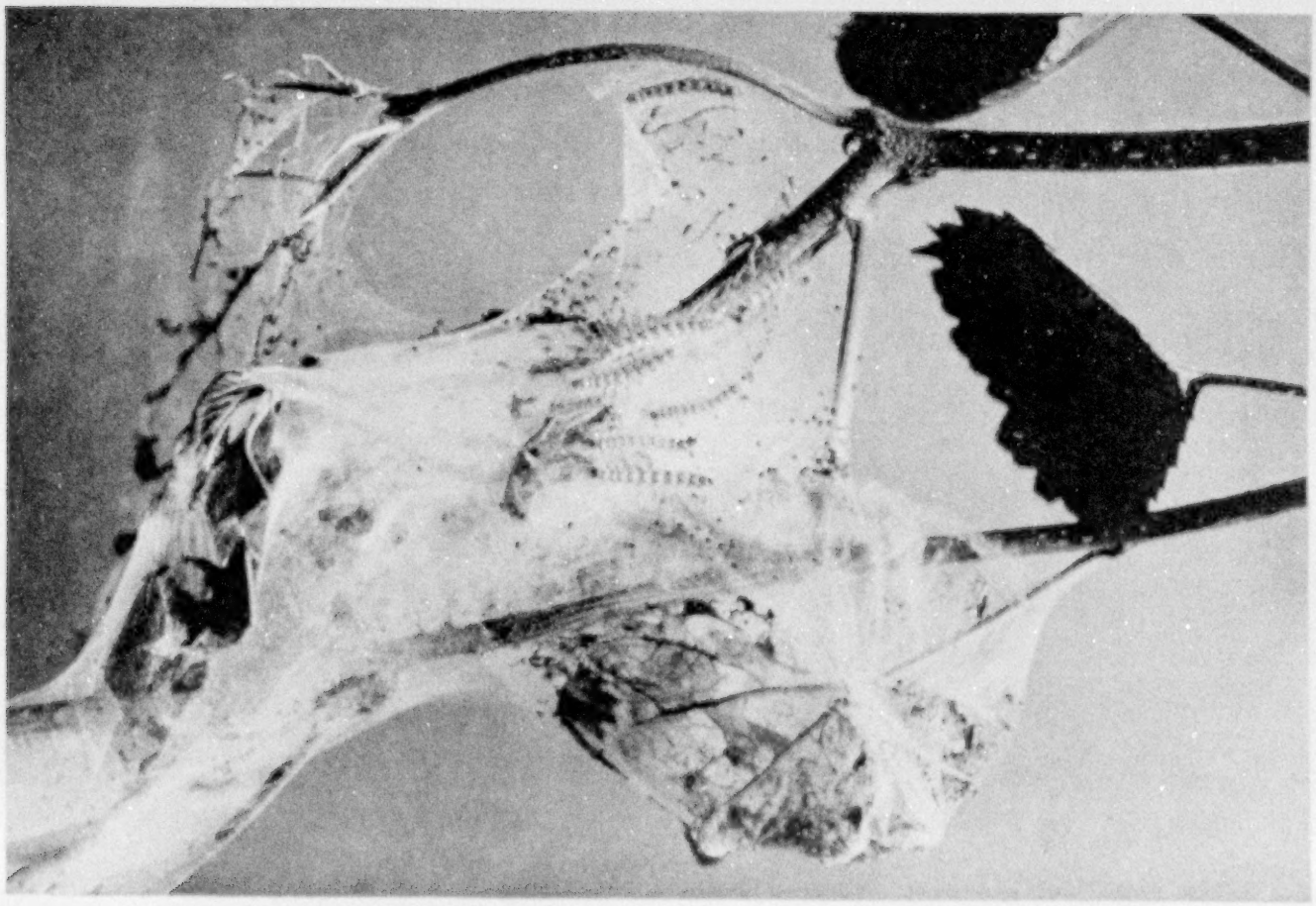
AN ATLAS MOTH FROM THE LONDON ZOÖLOGICAL GARDENS

With a wing-spread of ten inches the Atlas Moth is one of the largest of the Lepidopters. The smallest species of the order have a wing-spread of less than one-eighth of an inch.



BUTTERFLY AND MOTH EGGS ARE OFTEN OF STRIKING DESIGN

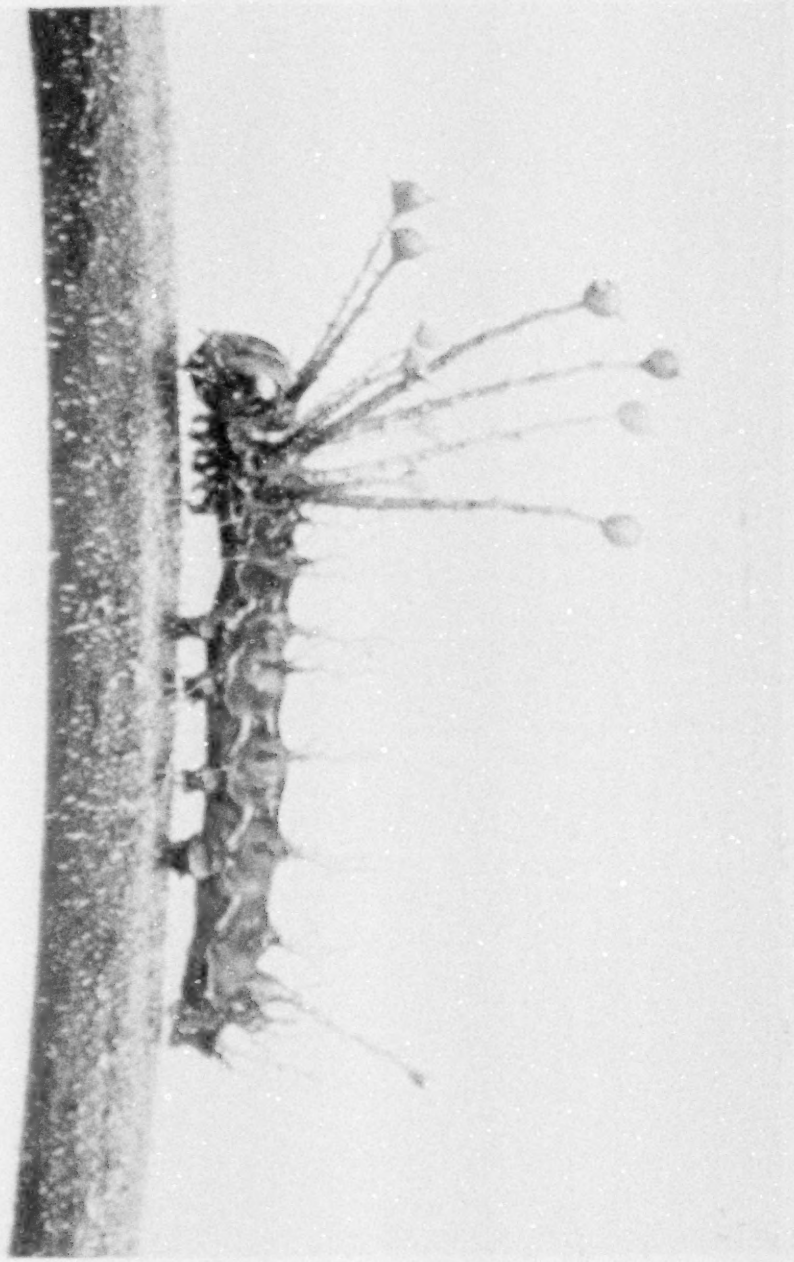
The eggs of butterflies are laid usually upon leaves. In most species the shells are beautiful when examined through a magnifying glass. The extreme summit is always a little rosette of the most exquisite delicacy, and the definite patterns of some eggs are such that we seem to be peering through the circular rose window of a microscopic Gothic cathedral (see text, page 91).



Photographs Courtesy U. S. Department of Agriculture

FALL WEB-WORMS ON A MULBERRY BRANCH

The tent caterpillars are social creatures, building their houses on the community plan. The moth of the Fall Web-worm is shown in figure 17 on Color Plate XIII.



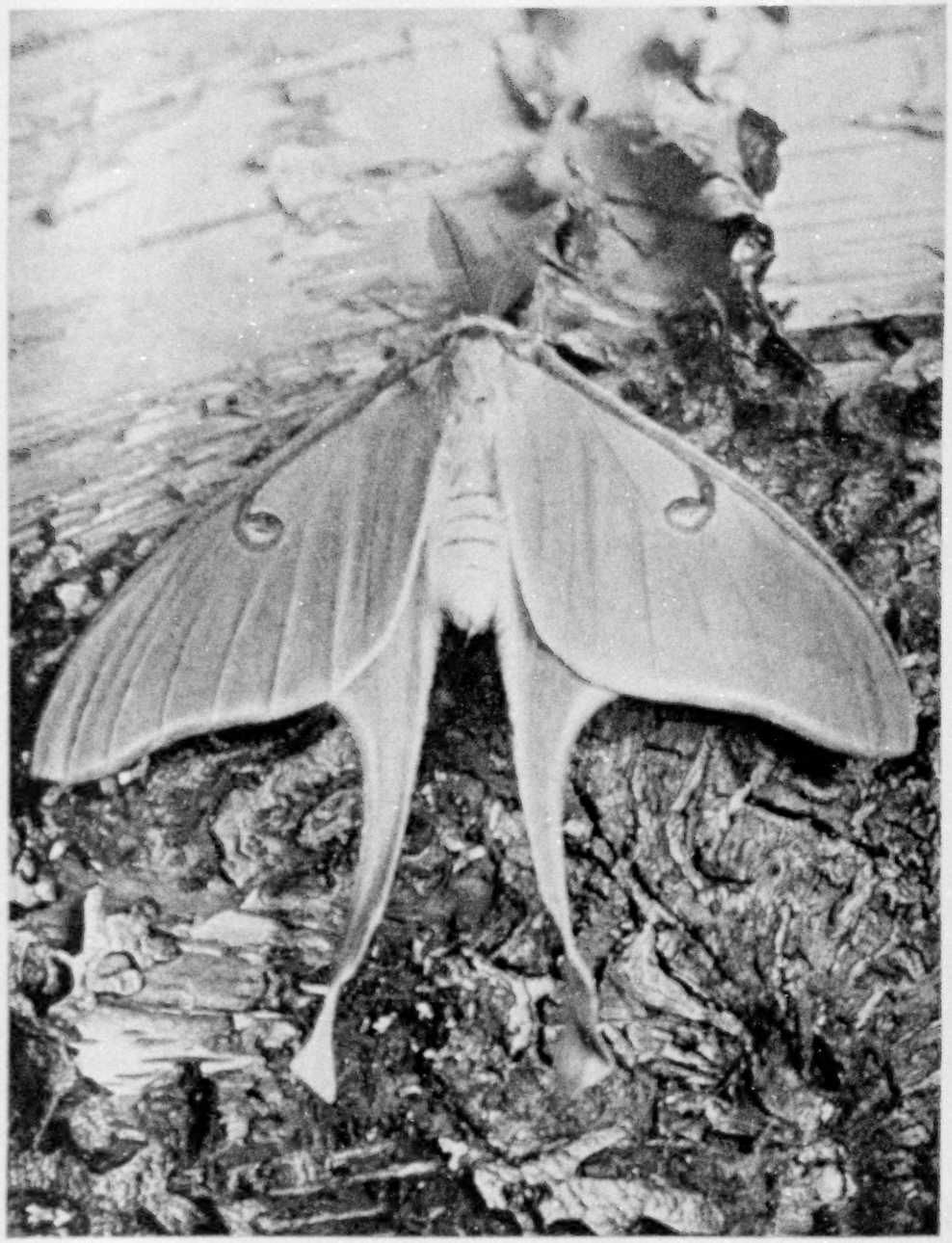
A CATERPILLAR OF THE ROYAL WALNUT-MOTH IN ITS EARLY YOUTH

Contrast this illustration with that of the Hickory Horn Devil (to the right). Many caterpillars undergo similar remarkable changes on their journey from the egg to the pupal case (see Color Plate I).

THE HICKORY HORN DEVIL, A MATURE CATERPILLAR OF THE ROYAL WALNUT-MOTH

The striking difference between the ugly larva and the beautiful moth is nowhere better illustrated than by contrasting this picture with figure 4 on Color Plate XIV.

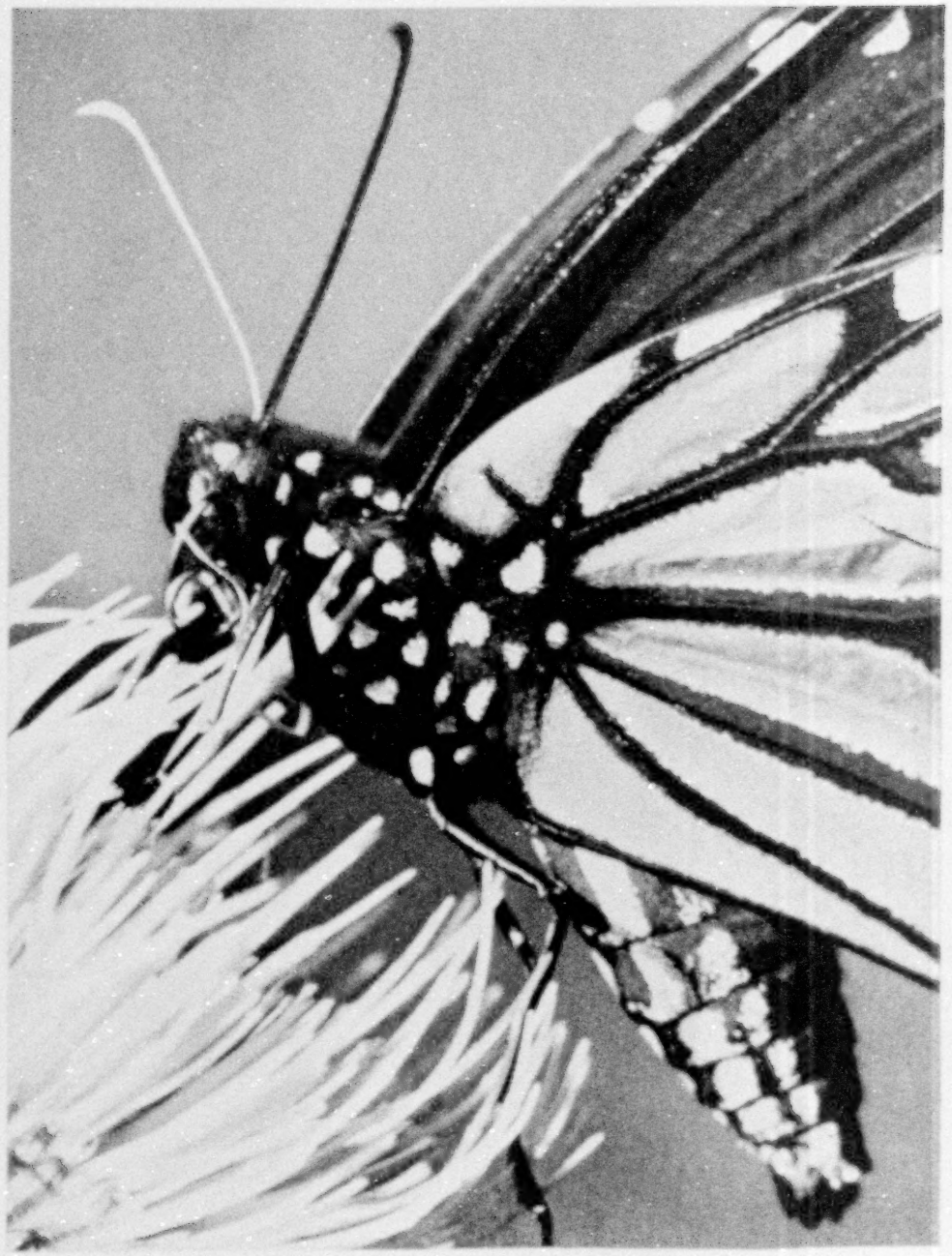
Photographs Courtesy U. S. Department of Agriculture



© Underwood & Underwood

A LUNA MOTH WHILE AT REST (SEE, ALSO, COLOR PLATE XV, FIGURE 4)

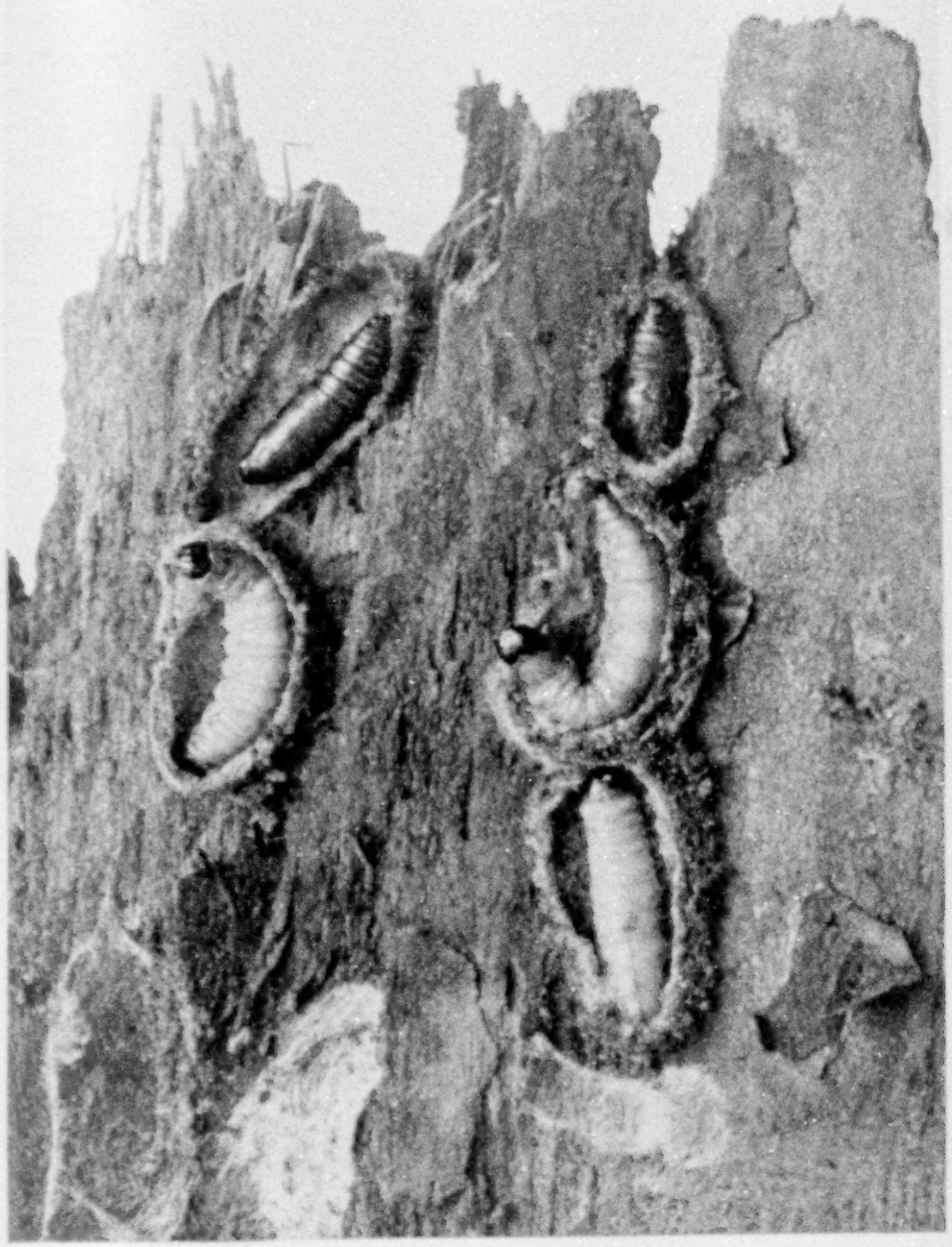
In the Color Plates accompanying this article the butterflies and moths are shown as in flight, but this photograph reveals a Luna Moth alight, with forewings folded over rear wings, blending into its surroundings.



Photograph by Paul Griswold Howes

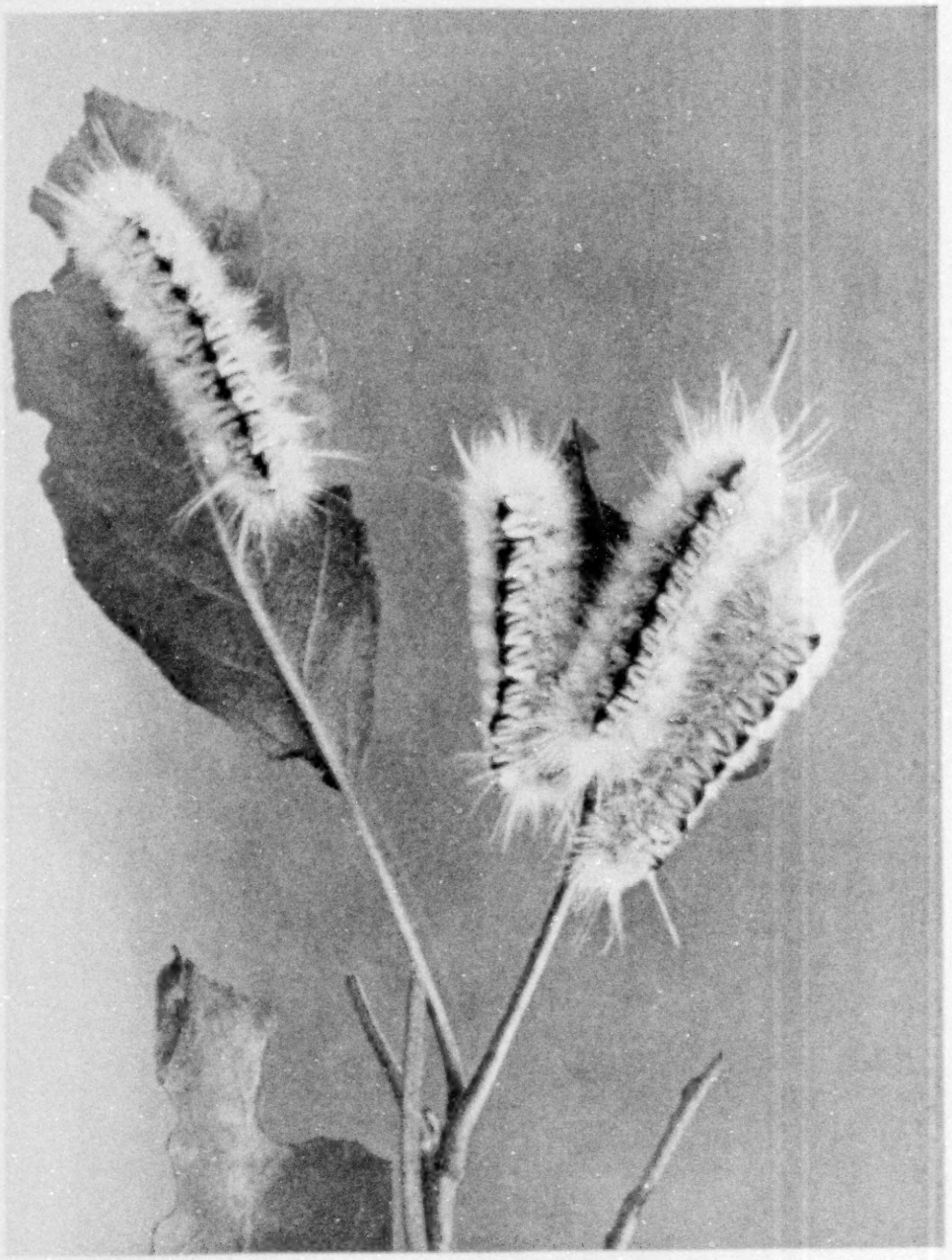
A MONARCH BUTTERFLY (SEE COLOR PLATE IX, FIGURE 12) SIPPING SWEETS FROM A THISTLE BLOSSOM

The coiled pumping tongues of butterflies and moths are ideally fitted for draining the nectar cups of the flowers. Moths, being, as a rule, more hairy than butterflies, are better pollen carriers.



LARVÆ AND PUPA (ENLARGED ONE-HALF) OF THE CODLING-MOTH, WHICH ATTACKS VARIOUS FRUITS

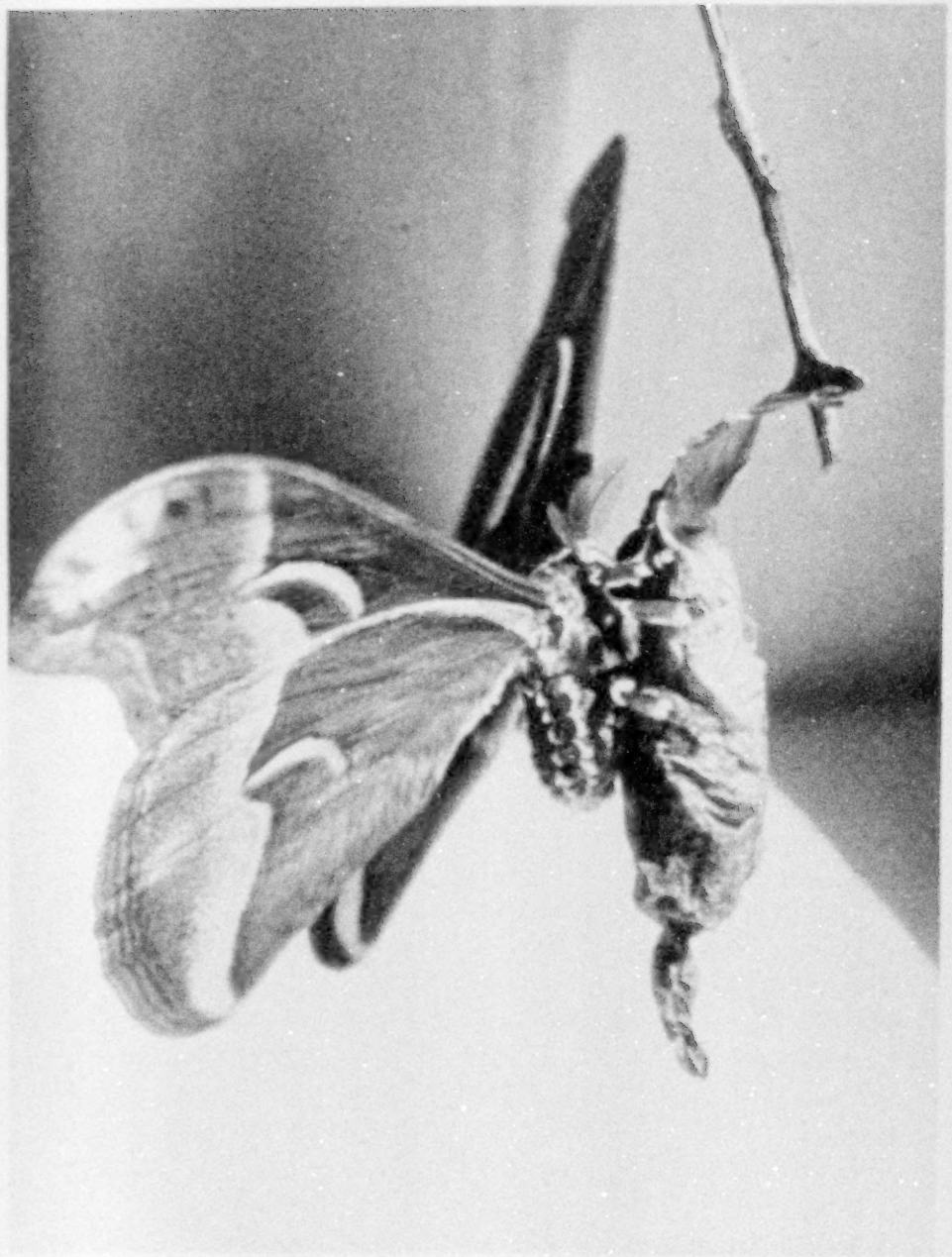
The eggs are laid on the fruit and the larvæ seek a convenient place to enter—usually at the calyx cup, the stem cavity, or an injured spot. After the fruit drops to the ground the larvæ emerge and make their cocoons as shown here.



CATERPILLARS OF THE HICKORY HALISIDOTA ON APPLE TWIGS AND LEAVES

The moth of this caterpillar is a cousin of the ones shown in figures 6 and 7 on Color Plate XIII. The stinging hairs of many caterpillars such as these are an effective means of defense against a large group of enemies.

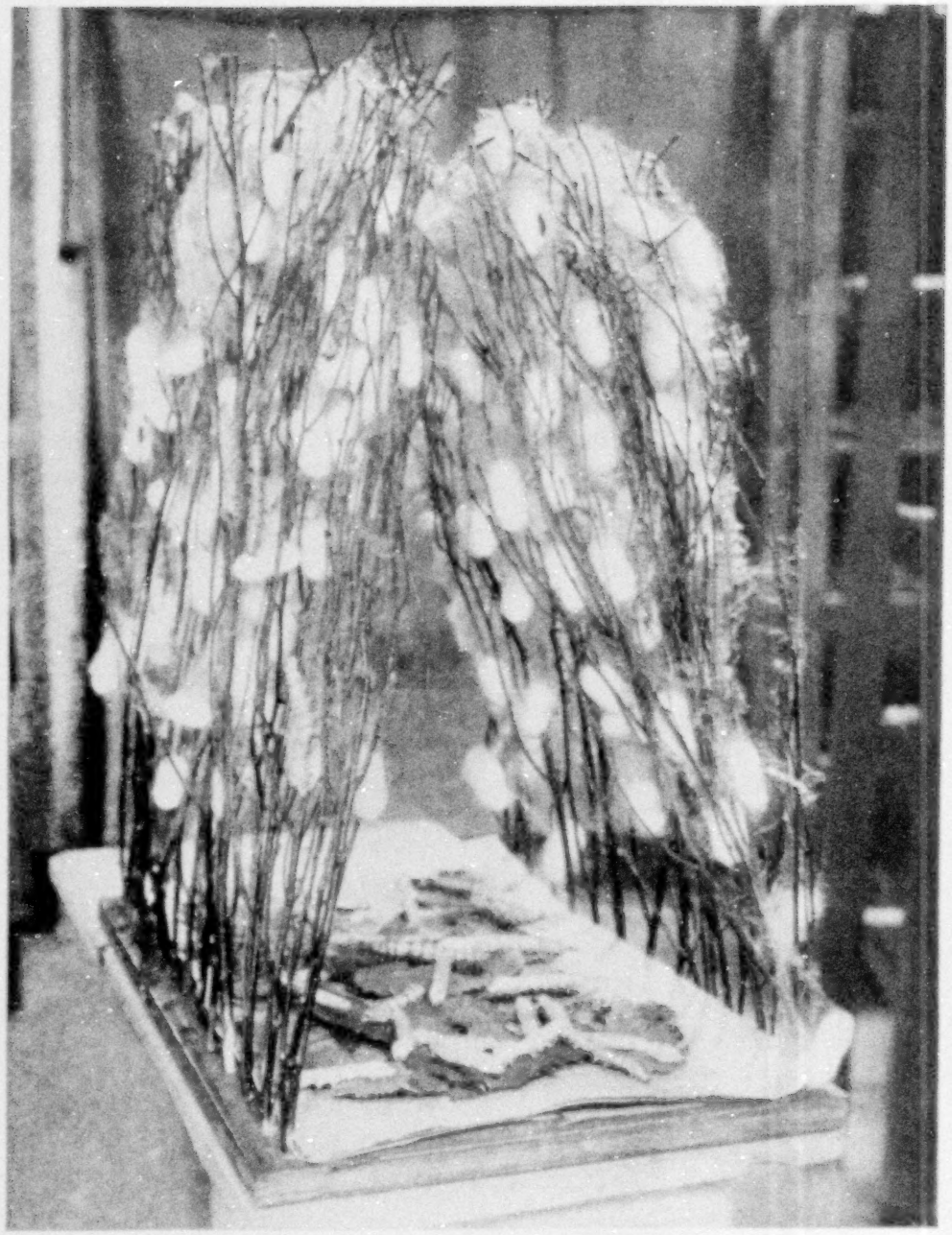
Photographs Courtesy U. S. Department of Agriculture



Photograph by Edwin L. Wisherd

AN AILANTHUS SILK-MOTH LEAVING ITS COCOON

The cocoon of this specimen was found on a tree in the back yard of a downtown Washington residence, and the moth emerged in the offices of the National Geographic Society, where it posed for its picture.



Wide World Photograph

THE BEGINNING OF A SILK DRESS

Some silkworms are feeding on mulberry leaves, others are climbing the brushwood of the spinning hut, and still others are fast asleep in their cocoons (see text, page 97).

to resemble the leaves among which they live, striped to simulate the pine needles on which they feed or the grass on which they dwell, or colored to match the ground on which they crawl, many of them being unbelievably hard to see in their accustomed surroundings.

There are all kinds of moth and butterfly foes—birds that take the adult on the wing or in repose or eat the caterpillars; parasites that attack both the eggs and the caterpillars, and scores of other creatures which consider them fair prey.

Camouflage is often practiced in a peculiar way. For example, our colorful friend, the Viceroy (see Color Plate II, figure 7), copies the Monarch (see Color Plate IX, figure 12) to perfection. Now, the Monarch happens to be a very distasteful creature to a bird because of its acrid blood; but a Viceroy makes a delightful titbit. The bird, because of wider experience with the Monarch, usually lets the similarly colored Viceroy severely alone.

This theory was tested on a monkey, who was given a Monarch to eat; he threw it aside in disgust. Next he was given a Viceroy, and as promptly he cast it aside. Then another Viceroy was offered, this time with the wings pulled off. It was eaten with evident relish.

Many other bird-relished species follow the practice of the Viceroy and imitate acrid varieties, thereby obtaining protection.

GAY COLORS DAZZLE THE PURSUER

Even the gay colorings of our gaudiest butterflies and moths are now thought by leading authorities to be protective, those who hold to this belief asserting that a woodpecker often loses a meal because disappearing brilliancy causes him to lose track of his quarry. As he chases a showy butterfly, his eye is full of the bright color, but when the insect alights it folds its wings above its back and, presto, the bright color disappears! Instead, it shows the drab hue of the underwing, harmonizing with its surroundings.

With the folding of its wings the insect becomes a part of its background and the thwarted woodpecker flies away, doubtless wondering how that bit of bright color escaped his hungry eye. One of the Orange Sulphurs of the Pikes Peak meadows, related to those shown on Color Plate IV, is green underneath. A brilliant flash of color while flying, it seems to vanish when it alights in the grass and closes its wings.

In the Kallima, or Dead-leaf Butterfly, this scheme is strikingly carried out. The underwing surface bears a remarkable resemblance to a leaf. It even has a hindwing projection which looks like the stem of a leaf, and a mark running across the wing appears to be a midrib. Perched on a twig, with closed wings, it perfectly simulates a dead leaf, but with outspread wings it is brilliant bait for a bird (see illustration, page 120).

In the case of the moths, which rest with folded wings instead of upright ones, as do the butterflies (see illustrations, page 85, and Color Plate XV), the brilliant color is on the rear wing, which is covered up by the somber forewing when the insect is at rest.

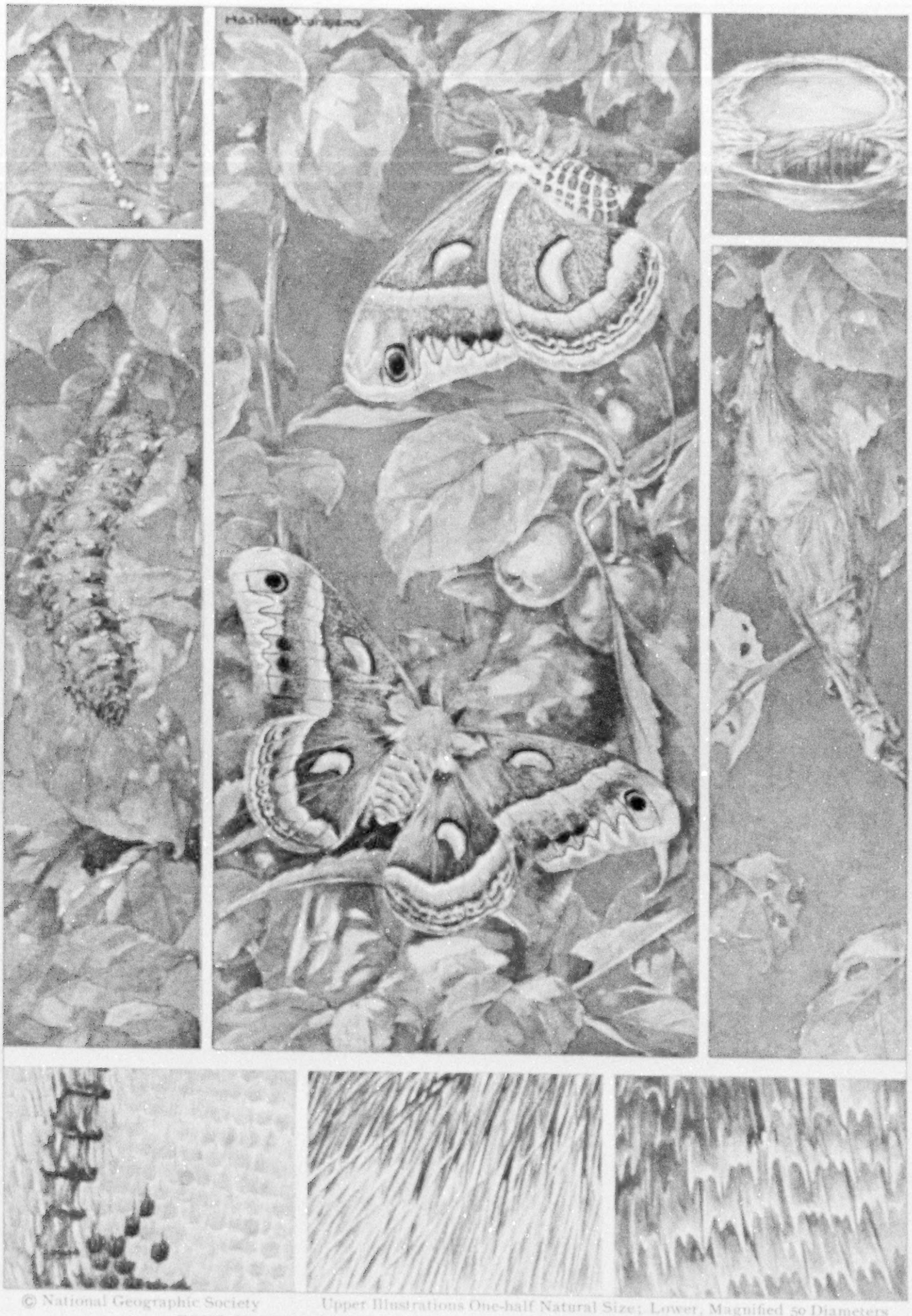
Studies of grasshoppers, locusts, and other winged insects show how this idea of disappearing brilliant colors runs through many families of the entire winged clan.

In collecting moths, one discovers that those which live among the birches usually have a coloration approximating the tones of birch bark, while those which are found usually on the trunks of maple trees show color schemes that make their visibility low. Figures 1 and 2 on Color Plate XII show the contrast between the two species, which are closely related.

But the beelike moths carry the art of camouflage even further than mere passive color protection. If captured or disturbed, they act exactly like the bees they simulate, give off the familiar bee odor, and even pretend to sting, in spite of the fact that they have no stinging apparatus.

MAKING MONSTERS OF THEMSELVES TO WIN PROTECTION

The caterpillars employ many of the arts of camouflage used by the adult butterflies and moths. The measuring-worms, larvæ of the Geometrid moths, simulate in color and general appearance the twigs on which they rest. Disturbed, they stand on their hind legs and look for all the world like small projecting shoots.

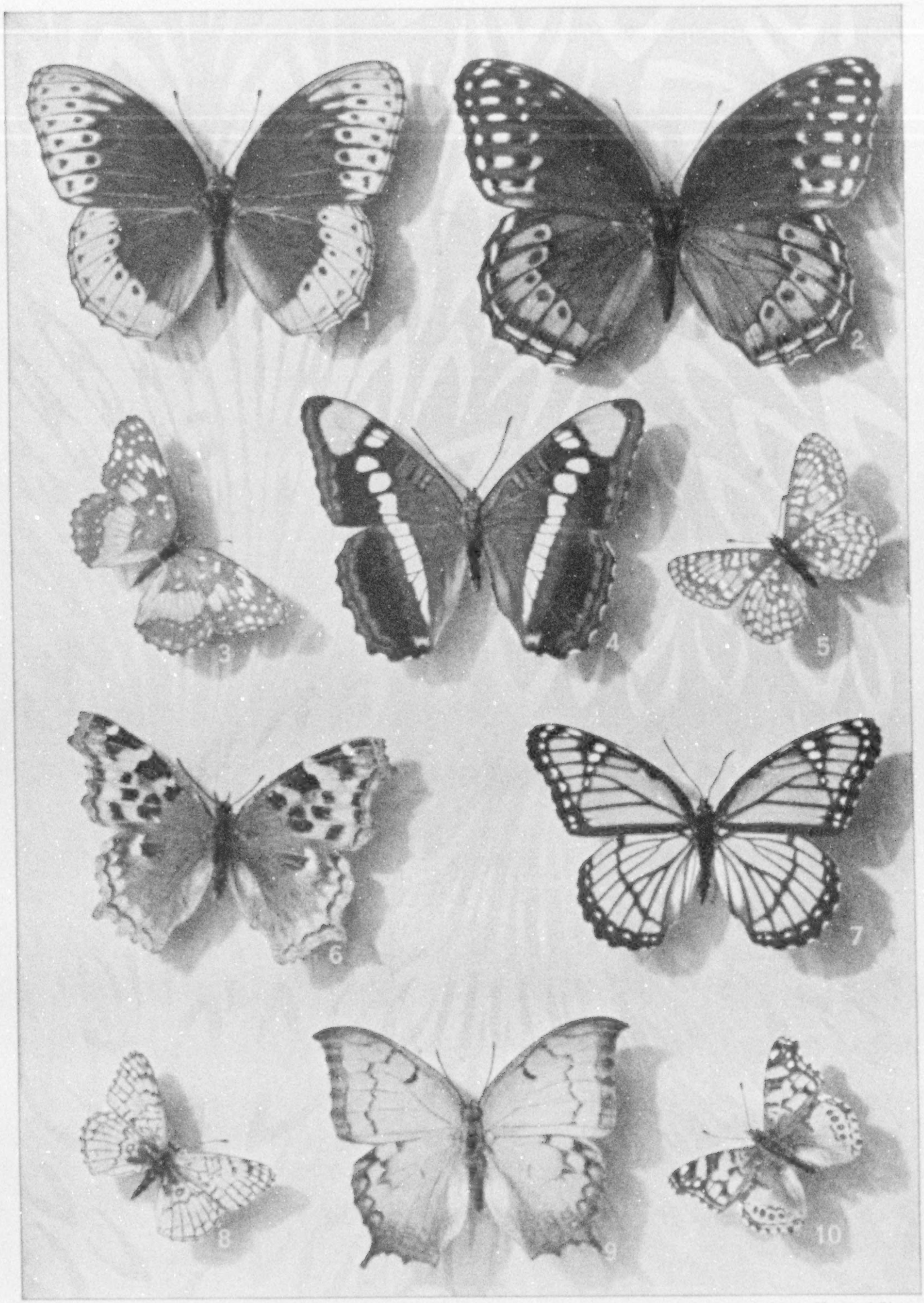


© National Geographic Society Upper Illustrations One-half Natural Size; Lower, Magnified 50 Diameters

FOUR SUCCESSIVE STAGES IN THE LIFE CYCLE OF A MOTH

Every butterfly and moth must pass through three metamorphic stages before it can become the beautiful winged creature with which we are familiar. Above is the Cecropia Moth, *Samia cecropia* L., a common Eastern species. Its eggs (upper left) are laid in the late spring or early summer. Upon emergence from the egg, the caterpillars are extremely small but soon increase in size, outgrowing their skin, which they shed. After the fourth molt the Cecropia (see panel below the eggs) spins a cocoon of silk (shown cut open at the upper right, and intact, below). From this it eventually emerges as a fullgrown moth.

At the bottom are three drawings showing the appearance, under a microscope, of the familiar "dust" on a butterfly's or moth's wings—actually a series of very fine scales and hairs. The drawing at the left shows the beautiful arrangement of the scales on the Gulf Fritillary Butterfly (see Color Plate III, figure 4); the center shows the forked hairs occurring on the wings of many moths; at the right are the scales of the Cecropia around the eyelike spots on the upper wings.



© National Geographic Society Two-thirds Natural Size

THEIR FLIGHTS SPRINKLE AMERICA'S LANDSCAPES WITH COLOR

(1) Diana Fritillary, *Argynnis diana* Cram. [Male]; (2) Diana Fritillary, *Argynnis diana* Cram. [Female]; (3) *Chlosyne lacinia* Gey.; (4) *Heterochroa bredowi* Hbn.; (5) *Euphydryas anicia* Dbldy. & Hew.; (6) Compton Tortoise, *Aglais j-album* Bdv. & Le Con.—also known as *Vanessa j-album;* (7) Viceroy, *Basilarchia archippus* Cram.; (8) *Melitaea neumoegeni* Skin.; (9) Portia Butterfly, *Anaea portia* Fabr.—also known as *Pyrrhanaea portia;* (10) *Vanessa carye* Hbn.

Many species of caterpillars protect themselves from their enemies by assuming a terrifying aspect. For example, the caterpillar of the Tiger Swallow-tail simulates a serpent (see illustration, page 79). The rings of the body just back of the head are swollen, and on top of this protuberance are two large circular marks suggesting eyes. When at rest the creature withdraws its real head and throws up the front part of its body, so that it resembles a snake's head—an impression made doubly effective as it pushes out its curious scent organ, which looks like a forked tongue. Birds have been observed to retreat in alarm as they suddenly came upon one of these menacing-looking, though harmless, creatures.

The Puss Moth, *Cerura,* has a caterpillar with a similar fearsome aspect, and when disturbed it displays a kind of forked tail, within which are concealed long orange-colored extensile threads that can be thrust out and waved viciously. Many other harmless species wear ugly horns, and even intelligent people cannot be induced to touch them.

Most of the Swallow-tail butterflies' caterpillars exude foul odors when disturbed, and Professor Comstock has called them the polecats of the insect world.

Even in the cocoons of some moths and the chrysalis cases of some butterflies, protective devices are employed. The Southern Live-oak Moth has a cocoon that very closely resembles a live-oak terminal bud, especially as both twigs and cocoons are covered with small bits of lichen.

As a decoy to distract the attention of its enemy, the striking Banded Purple butterfly's caterpillar loosely fastens near its feeding place a small ball of leaf scraps closely resembling itself.

PARASITES CONVERT BUTTERFLY EGGS INTO FAMILY NURSERIES

The eggs of butterflies are laid usually upon leaves. In most species the architecture of the shells is beautiful when examined through a magnifying glass. "The extreme summit is always carved by a little rosette of the most exquisite delicacy, often requiring some of the higher powers of the microscope to discern, but arranged in such definite patterns that in looking at them we seem to be peering through the circular rose window of a miniature Gothic cathedral" (see page 83).

The chances of a butterfly's egg producing a live caterpillar are surprisingly small. Ants and spiders regard these eggs as a great delicacy, and a whole group of tiny insects of the fly and bee orders, almost too small to breathe, one would think, insert their eggs into those of the butterflies. Parasites are always on the job to convert the butterfly's egg into a nursery for their own young.

In the case of the Viceroy and its cousins, the female butterfly lays her eggs one at a time and, unless in a hurry to be rid of the task, only one to a bush. She lays them on the tips of the leaves, as a rule. Her eggs are covered with little hairs to protect them.

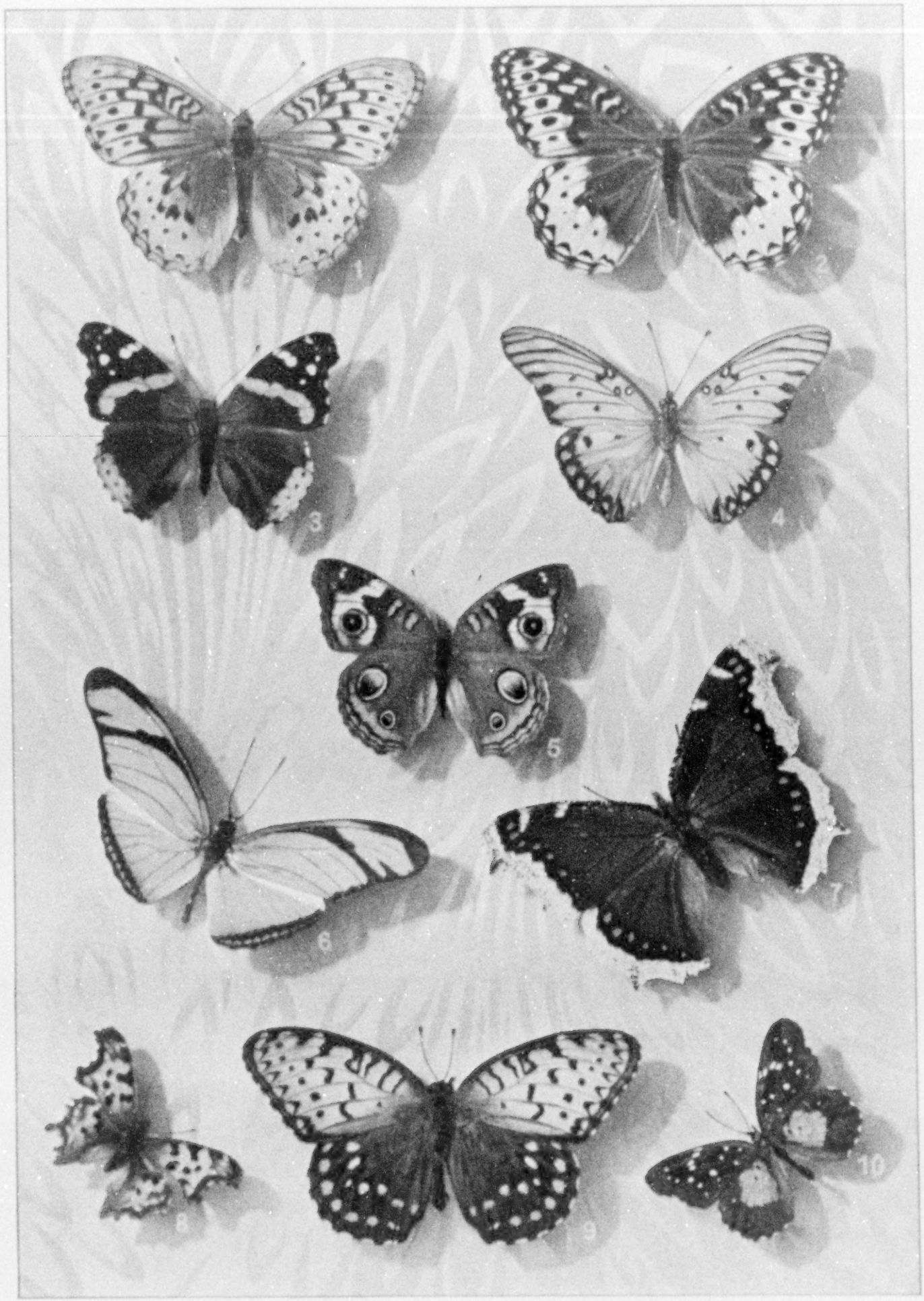
But, with all the effort to conceal her eggs and to safeguard them, Madam Viceroy is not very successful, for a large majority are found to be parasitized.

Some butterflies and moths lay their eggs in rings around twigs and cover them up with a sort of varnish. The Brown-tail Moth covers hers with hairs from her own body, her tail having a bunch of these ready for application to the eggs as soon as laid.

When the caterpillars hatch out, most of them make it their first duty to eat the shells out of which they have just emerged. In the Viceroy the larva then begins to eat the leaf, leaving the midrib.

After having a hearty meal, it retires toward the end of the stripped midrib, digests its meal in the safety of its isolation, and then comes down for another feast. It makes a little packet from bits of midrib and other refuse and uses this as a sort of insect scarecrow, always keeping it at the point on the midrib where the edge of the uneaten portion of the leaf joins it.

Parasites are the bane of the caterpillars as well as of the eggs. All sorts of fly and bee order insects hover around watching for a chance to plant an egg on their bodies. A surprisingly large percentage of them must play unwilling host to the larvæ of these foes. When the parasites' eggs hatch, their little grubs bore into the bodies of their hosts and find a fine food supply in the tissues. A single caterpillar



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Two-thirds Natural Size

THE DAPPER BUCKEYE AND THE STATELY REGAL FRITILLARY ARE FAMILIAR FRIENDS

(1) Leto Fritillary, *Argynnis leto* Behr. [Male]; (2) Leto Fritillary, *Argynnis leto* Behr. [Female]; (3) Red Admiral, *Vanessa atalanta* L.; (4) Gulf Fritillary, *Dione vanillae* L.; (5) Buckeye, *Junonia coenia* Hbn.; (6) Delila, *Colaenis delila* Fabr.; (7) Mourning-cloak, *Aglais antiopa* L.—also known as *Vanessa antiopa;* (8) Wandering Comma, *Polygonia satyrus* Edw.; (9) Regal Fritillary, *Argynnis idalia* Dru.; (10) Crimson-patch, *Synchloe janais* Dru.

may be unwilling host to a dozen parasites, and finally dies about the time the unwelcome guests are ready to pupate. Some parasites lay single eggs, from which as many as 300 larvæ hatch (see illustration, page 80). They are all of one sex, being in reality a single individual subdivided by witchery more subtle than the art of the greatest magician of fairy story. Polyembryony (meaning many individuals from a single egg) is one of the most marvelous of all the recent discoveries in biology.

The caterpillars thrash their heads and tails about when the parasites come around them, and some species, like some of the Sphinx moths, make clicking and squeaking noises.

The gamut which a caterpillar has to run to realize its ambition to reach the winged stage is shown by the researches of Slingerland and Crosby, who found that in some localities 90 per cent of the Tussock Moth caterpillars and chrysalids fell victims to parasites. Twenty different species of flies and hymenopters parasitized those studied.

But often a parasite is "hoist with his own petard," for 14 parasites were found preying on the Tussock Moth's parasites. And then these, in their turn, had parasites attacking them, reminding one of Dean Swift's famous bit of doggerel:

> So naturalists observe a flea
> Hath smaller fleas, that on him prey;
> And these have smaller still to bite 'em,
> And so proceed *ad infinitum*.

THE PSYCHE CATERPILLAR MAKES ITSELF A SUIT OF CLOTHES

Most caterpillars undergo four molts in reaching full growth, though some have been known to pass eight molts. Some change their color pattern after each molt, and most of them, preparing to molt, spin a silk web in which to entangle the legs of the old skin, so that it will remain anchored while they are escaping.

Some caterpillars roll up leaves and make themselves individual shelters. Some species occupy these shelters when not feeding, which therefore last during their full larval life; others feed upon the walls of their abode, building a new shelter when they "eat themselves out of house and home."

But there are others which make themselves suits of clothes.

Whoever has failed to read Fabre's story of the life habits of the Psyche Moth and its caterpillar's coat has missed one of the gems of entomological literature.

Commonly known as the bagworm, the Psyche caterpillar, on emerging from the egg, starts in to build a suit of clothes. Standing on its front legs and holding its tail upright, the naked creature spins a ring of silk, adding bits of wood, leaves, etc., thereto. It continues to spin, adding to the lower edge of the ring until the latter forms a sort of cone.

As the worm grows, it enlarges the bag much after the fashion that hornets enlarge their nests. When the coat gets too heavy, the worm lets it hang down, and henceforth the creature thus encumbered must crawl around on its front legs, encased in a hard, stiff, rough armor.

Finally the migratory instinct subsides and the bagworm settles down on the twig of a tree that will constitute the food of its successor. After fastening its wood-embroidered garment to the twig, the insect lines the former with heavy silk, rests awhile, casts its skin, and becomes a chrysalis.

Three weeks later the male chrysalis works himself down to the bottom of his bag, bursts the pupal skin asunder, emerges a full-fledged moth, and as soon as the glue that reinforces his wings is hardened he goes in quest of his mate.

And what a poor creature this mate is. Wingless and footless, she is doomed to die in the home she has built. She creeps down out of her chrysalis skin, welcomes her mate at the door of her house, backs into her chrysalis skin again, fills it partially with eggs, seals it up with what little is left of her body, and dies.

A CATERPILLAR THAT STARS IN THE RÔLE OF WEATHER FORECASTER

Most of us are familiar with the tent caterpillars of spring, summer, and fall. Closely related to our everyday apple tree tent caterpillar is the Pine Processionary of France, which Fabre proved to be at once the prize "bone head" and the blue ribbon weather forecaster of the insect world (see illustration, page 82).

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THE IMMIGRANT CABBAGE BUTTERFLY AND SOME OF ITS YELLOW AND SULPHUR RELATIVES

(1) Orange Sulphur, *Eurymus eurytheme* Bdv. [Male]; (2) Orange Sulphur, *Eurymus eurytheme* Bdv. [Female]; (3) Orange Sulphur, *Eurymus eurytheme* Bdv. [Female]; (4) Cloudless Sulphur, *Catopsilia eubule* L. [Male]; (5) Cloudless Sulphur, *Catopsilia eubule* L. [Female]; (6) Orange-tip, *Anthocharis sara* Bdv.; (7) Large Orange Sulphur, *Catopsilia agarithe* Bdv.; (8) Cabbage Butterfly, *Pieris rapae* L.; (9) Dog's-head Butterfly, *Zerene caesonia* Stoll.—also known as *Meganostoma caesonia*; (10) Zerene Dog's-head Butterfly, *Zerene eurydice* Bdv. [Male]; (11) Clouded Sulphur, *Eurymus philodice* Godt.; (12) *Eurema proterpia* Fabr.; (13) Zerene Dog's-head Butterfly, *Zerene eurydice* Bdv. [Female].

These Processionaries live in tents. The whole tribe marches out, head to tail, single file, in quest of food. Each spins a life line to guide its footsteps back to the nest when its foraging is at an end.

The great French naturalist was able to get a foraging party of Processionary caterpillars on the rim of a huge lawn vase, and then to cut away the life line leading back to the nest. The caterpillars traveled around, came back to the point where the line was cut away, picked up the part they had laid around the vase, and marched around again.

All day long they kept following the line around and around. Night overtook them; they slept, but with the morrow's sun started marching around again.

The second night came, the third, the fourth, and the fifth; the sixth day dawned, and again they resumed the bootless march. For seven days they marched around and around, and were able to find their way back to the nest on the eighth only when one wandering caterpillar, crawling out of the procession in desperation, staked out a highway which the footsore band later decided blindly to follow.

Sight told them nothing, for nine inches away were branches laden with pine needles. Smell gave them no inkling, for almost under their noses was an abundance of their fragrant, favorite diet.

And yet, as a weather forecaster, the Pine Processionary is a marvel. It does not like to be caught out in a storm; so it always stays in its nest when storms are brewing. In its back are protuberances formed of soft, pale, hairless membrane. Of infinite sensitivity, these are supposed to be the antennæ which detect the meteorological waves that tell the caterpillar of approaching bad weather. They appear and disappear at the caterpillars' will—the figurative straws that tell them how the wind blows. And Fabre reports that his caterpillars were better long-range weather forecasters than his government's meteorological station.

ANTS FEAST ON A HONEY WHICH THEY MILK FROM CATERPILLARS

The caterpillars of some butterflies appear to have entered into what human beings would call working agreements with ants. For instance, the caterpillars of the Common Blue or Spring Azure butterfly are attended by ants, who, touching their bodies, get them to exude a sweet fluid from abdominal glands, which the ants drink with relish, just as we milk cows and enjoy the milk. Some of the Hair-streaks (see Color Plate VII)—probably all of them—are attended by ants when in their caterpillar stage. Some of the caterpillars stay in the ants' nests when not out eating.

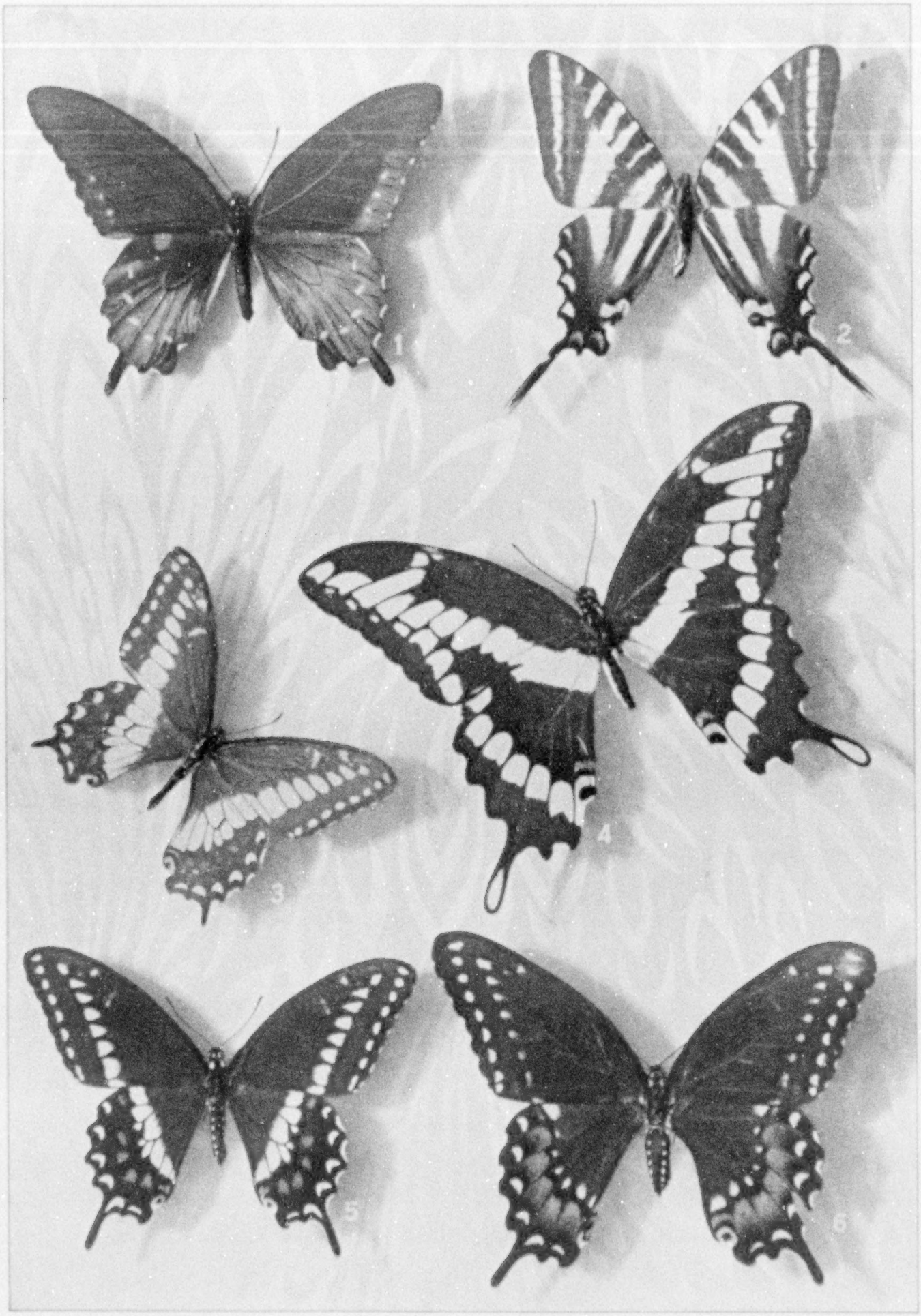
The bee moth and her larvæ live in the hives of bees. When Madame Moth first enters a hive she does it by stealth, in the night, when the bee household is asleep. If she dares to do otherwise, she is stung to death. The hive odor is the countersign to those who would pass the bee's sentries, and the moth which cannot outwit sleeping sentinels is sure to get a reception that is warm, to say the least.

There are scores of burrowing caterpillars which creep up into the stems and down into the roots of briers, small shrubs, vines, and even trees. The straight wood borers, which grub their way through the hardest oak and locust wood and spend three and four years in the heart of the tree, always come to the surface to make a pupating chamber, which has just enough curtain over the window to keep a woodpecker from looking in.

Though spending three or four years as grubs in the tree and having mouths that can masticate hard wood, the emerging moths have neither mouths nor tongues. Their eating has been done for them by their larvæ. They have a very few hours to live—just long enough for a chance to find a mate and die.

MAN HAS DOMESTICATED ONLY TWO INSECTS

Most of the butterflies pupate without spinning cocoons, while many of the moths have cocoons. Some pupate on the ground, some in the grass, some under the ground, some in grain. A thousand plans are followed. Some species of American Saturnids (see Color Plate XVI) spin such excellent cocoons that they would probably be utilized in this country in the production of silk if labor



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THE SWALLOW-TAILS VIE WITH THE FRITILLARIES FOR HONORS IN THE BEAUTY CONTEST OF THE BUTTERFLY WORLD

(1) Blue Swallow-tail, *Papilio philenor* L.; (2) Zebra Swallow-tail, *Papilio marcellus* Cram.—also known as *Iphidicles ajax marcellus;* (3) Black Swallow-tail, *Papilio polyxenes* Fabr. form *americus* Koll.; (4) Giant Swallow-tail, *Papilio cresphontes* Cram.; (5) Black Swallow-tail, *Papilio polyxenes* Fabr. form *asterius* Cram. [Male]; (6) Black Swallow-tail, *Papilio polyxenes* Fabr. form *asterius* Cram. [Female].

were as cheap and living as hard as in China and Japan.

The silkworm, whose cocoon China taught the world the art of using in the fashioning of the world's finest textiles, shares with the honeybee the distinction of being the only domesticated insects in the world.

The statistics of sericulture show that the world production of the silkworm's thread amounts, exclusive of the undetermined quantity produced and used in the interior of China, to nearly 90,000,000 pounds a year.

As there are more than 900 miles of silk fiber in each pound, one may gain some conception of the enormous industry of these larvæ of the silkworm moth, *Bombyx mori*, and related species, the latter producing only a small share of the total.

40,000 SILKWORM EGGS TO THE OUNCE

The eggs are laid once a year, in the summer, and are so small that 40,000 of them weigh only an ounce. They hatch the following spring. In about six weeks and after four molts the caterpillars are full grown and are about three inches long. They then are ready to pupate.

After a restless search the silkworm finds a small twig, produces from the spinneret, a tiny orifice in the lower lip, a bit of sticky, viscid fibroin, which quickly dries and adheres to the twig. By a series of waving motions with its head and a circular motion with its body, it draws out the fibroin in the shape of a minute double thread, slightly twisted, and with it a silk gum that cements the two threads together (see page 87).

The worm seldom stops until its cocoon is complete, and produces from 500 to 1,300 yards of silk thread for the task. Those cocoons that are wanted for silk are usually subjected to heat and the insects killed; but where particularly brilliant silks are desired, the fiber is reeled from the cocoon while the worm is still alive.

Those cocoons selected for "seed" are kept, and in from 20 to 40 days the moth emerges—a poor, bedraggled creature, with mouth incapable of eating anything and with wings too weak for flight. After mating, the female lays her eggs and dies—a melancholy victim of centuries of domestication and specialization in silk production.

Transcontinental silk trains, moving without schedule and having the right of way over even the crack limited expresses, rush from Vancouver to New York with the product of billions of these little laborers of the Orient that produce the raw material for the sheerest of hose and the heaviest of brocades.

THE SILKWORM'S RIGHT TO A NICHE IN THE HALL OF FAME

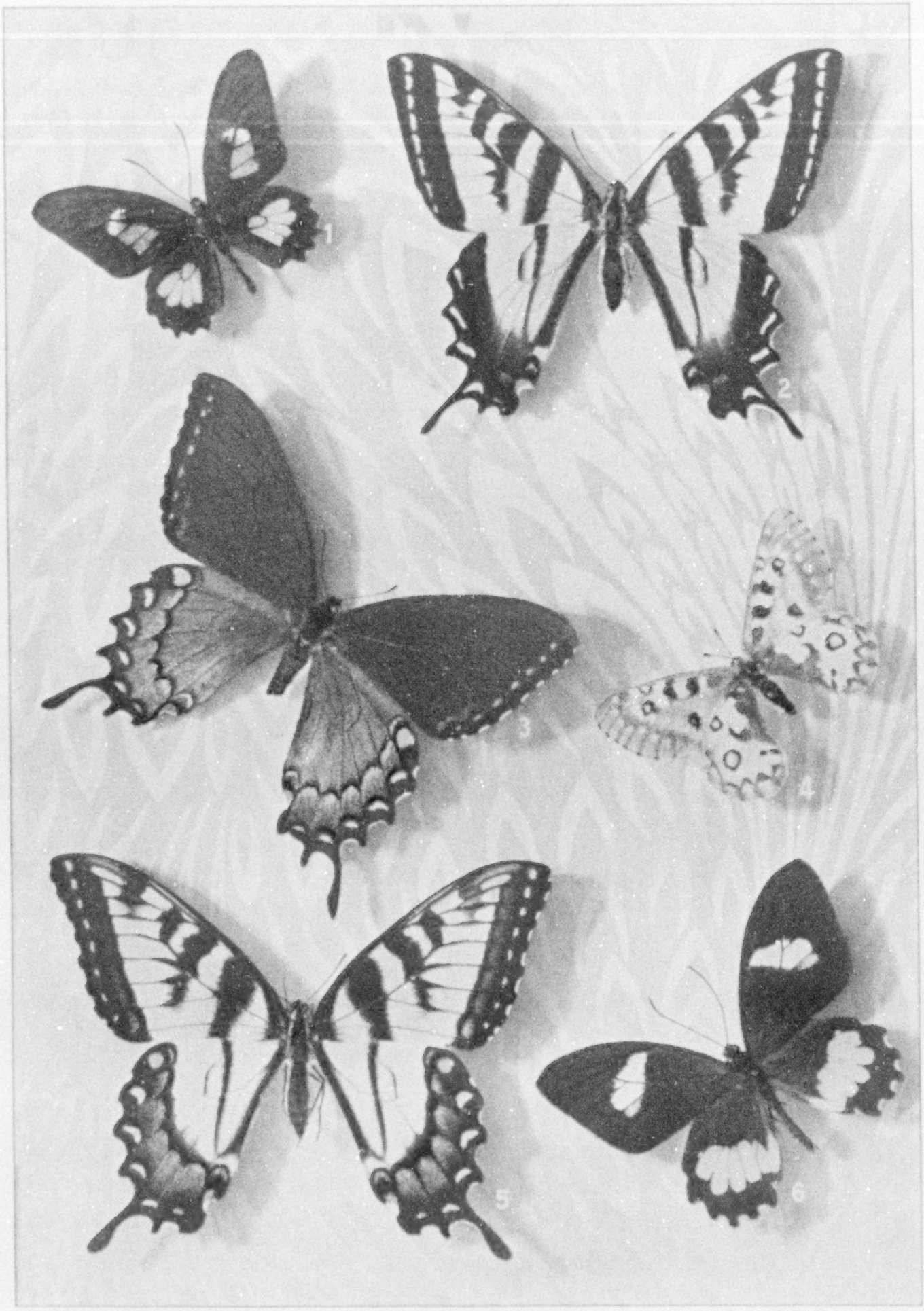
The silkworm deserves a niche in the Hall of Fame for another reason besides its gift of the world's most prized textile: it was the story that the sick silkworms of France told the great Pasteur which led him from his beloved crystals into the study of contagious disease and the science of bacteriology, with a resultant marvelous saving of human life.

Chrysalids range from the beautiful to the ugly. The Milkweed Butterfly has a charming green house with golden nails; the Violet-tip possesses one colored like dead leaves, marked with a Roman nose, and studded with silver or gold spots.

During its nymphal slumber great changes take place in the chrysalis. Practically the entire structure of the caterpillar is torn down. Its organs, its muscles, its entire being, except a few nerve centers, are thrown into the caldron of change and reduced to a sort of milky chyle.

But certain buds, which may be detected in the caterpillar at the beginning of the pupating process, begin to take form, becoming wings, tongues, compound eyes, etc.

In due course, sometimes in a few weeks, at others after the passing of a winter, the inert mass concealed within and cemented to the outer integument of the pupal cast awakens to life, and there emerges, in the words of Scudder, "like well-clad Minerva from the head of Jove, a creature of no apparent kinship either with the case that enwrapped it or the lowly worm that preceded it; a creature with a soft, elastic body, buoyant as the air in which it floats, with spreading feelers and broad spanned wings, clothed with jeweled dust and silken hair, which



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THE TIGER SWALLOW-TAIL (2) HAS MATES OF TWO DISTINCT COLORS (3 AND 5)

(1) *Papilio mylotes* Bates. [Male]; (2) Tiger Swallow-tail, *Papilio glaucus* L. [Male]; (3) Tiger Swallow-tail, *Papilio glaucus* L. form *glaucus* [Female]; (4) Parnassian Butterfly, *Parnassius sminthcus* Dbldy. & Hew. [Female]; (5) Tiger Swallow-tail, *Papilio glaucus* L. form *turnus* [Female]; (6) *Papilio mylotes* Bates. [Female].

reflect the colors of the rainbow and in their delicate combinations defy the painter's palette."

THE BIRTH OF A BUTTERFLY

Creeping out of its pupal case, the butterfly rests with its back downward and its wings limp. With a violent pumping of its abdomen, it forces a liquid glue out through the hollow veins of the wings, between the upper and lower membranes, and even into the scales themselves. When this glue hardens, the veins become solid struts instead of hollow tubes, the upper and lower membranes become permanently bound together, the scales assume color and shape, and the insect becomes a new-blown, full-grown butterfly, ready to fly away into the romance of adult existence.

The scales that arrange themselves in such marvelous patterns on the wings of moths and butterflies are modified hairs. Under the microscope one sees every gradation from a thoroughly orthodox, elongated hair to the broad, corrugated, serrated scale. As will be noted in the microscopic section at the bottom of Color Plate I and the drawing, page 78, one may see the whole series on the wings of a moth and butterfly.

The tongues of butterflies and moths are marvelous adaptations to their needs as nectar sippers. Some, as in the case of several of the Sphinx moths, may be as much as six inches long, two or three times the length of the insects' bodies (see Color Plate X, figure 7). When not in use, they coil up like the hairsprings of watches and are concealed under little hairy tippets projecting on either side of the coil.

The tongue consists of two sections, so joined together that the groove on the inner side of each forms one-half of the hollow tube they jointly make. Through this the insect draws the nectar out of the flower much as we draw ink out of a bottle with a fountain-pen dropper.

SOME MOTHS AND BUTTERFLIES NEVER EAT

In many cases these tongues are so long that in the pupal cases special coverings are provided for them. The natives of the South, noting the similarity of these tongue cases to wind instruments, call the pupæ bearing them "horn-blowers."

The mouth parts of the scaly-wing order range from this high specialization on down to the simple biting kind, such as are possessed by locusts and beetles.

In some of the butterflies and moths, like the silkworm moth, the period of adult existence is so short that they never eat. Consequently, their mouth parts have completely atrophied and starvation would be their inevitable fate if early death in other forms did not sooner supervene.

It is an interesting fact that, with but rare exceptions, the lowest forms of scaly-wing life fly by night, the middle forms by twilight, and the highest forms by day. It is likewise to be noted that, with only a few exceptions, the lowest forms are the most nearly colorless, and the highest forms the most colorful.

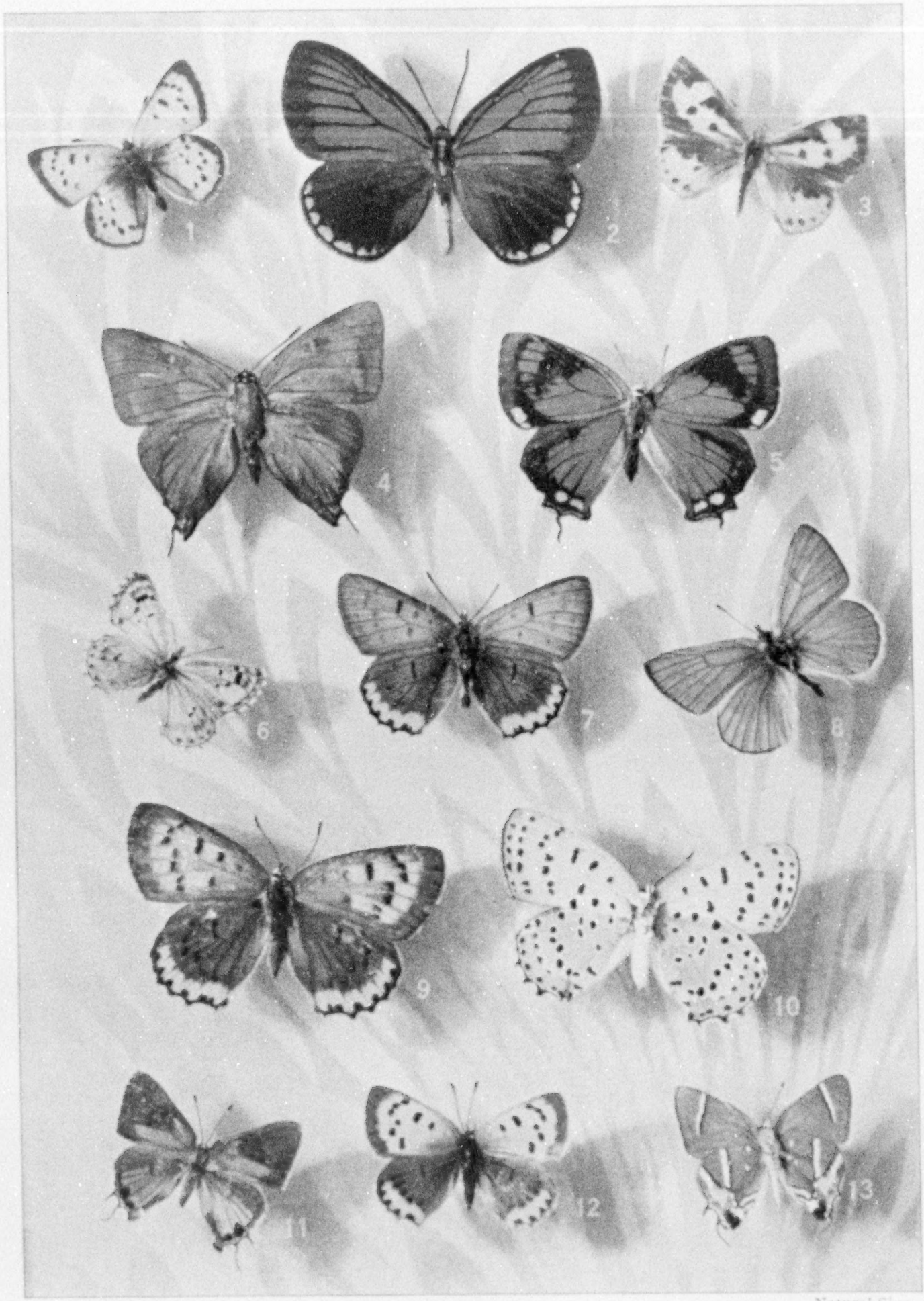
BUTTERFLY BROTHERS AND SISTERS DIFFER RADICALLY

Some butterflies have a single generation a year, others produce two broods, and still others three broods. In some cases the different broods are so different that they long were thought to be of different species. For instance, the familiar Cabbage Butterfly (see Color Plate IV, figure 8) is smaller and of a duller white in the spring brood than in later ones, and possesses broader black markings on the tip and middle of the wings.

In the American Copper spring individuals are of a more fiery red and have broader orange bands on the surface of the hind wings than later broods. Likewise, the Pearl Crescent of spring is so different from that of midsummer that the two broods passed for different species until the observant Edwards proved the contrary.

The second type of dimorphism is illustrated in the Violet-tip, where there are two forms arising from the same brood, differing alike in the brightness and variegation of their colors and in the form of the wing itself. The Blue-eyed Grayling is another which has two forms that were long able to masquerade as different species.

Then there comes a third type of dimorphism that is a mixture of both. The



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A FEW OF THE COPPERS AND THEIR KIN

(1) *Heodes cupreus* Edw.; (2) Atala, *Eumaeus atala* Poey; (3) Wanderer, *Feniseca tarquinius* Fabr.; (4) Great Purple Hair-streak, *Atlides halesus* Hbn.—also known as *Thecla halesus*; (5) *Hypaurotis crysalus* Edw.; (6) *Philotes sonorensis* Feld.; (7) Bronze Copper, *Heodes thoe* Bdv. [Male]—also known as *Chrysophanus thoe*; (8) *Glaucopsyche lygdamus* Dbldy.; (9) Bronze Copper, *Heodes thoe* Bdv. [Female]—see No. 7; (10) Bronze Copper, *Heodes thoe* Bdv. [Underside]—see No. 7; (11) *Strymon martialis* H. S.; (12) American Copper, *Heodes hypophlaeas* Bdv.; (13) *Strymon acis* Dru. [Underside].

Zebra Swallow-tail (see Color Plate V, figure 2) is an example of this type. It appears in three forms—*Papilio marcellus*, the *Iphidicles ajax marcellus* of the field books, emerging in early spring, with tails three-fourths of an inch long and tipped with white; *Iphidicles ajax telamonides*, appearing in late spring, with tails a little longer and bordered with white on either side for half the length or more; and the simple *Iphidicles ajax*. *Marcellus* and *telamonides* come from a single brood, *marcellus* hatching earlier. *Ajax* comes from the eggs of *marcellus* and *telamonides* alike. Its eggs in turn produce *marcellus* and *telamonides* in the spring.

In the case of the Pearl Crescent, which has both spring and summer forms, the summer form may be made to take the coloring of the spring form simply by chilling the chrysalis, which indicates the rôle played by winter in producing the spring form.

SPRING AZURE HAS MANY COLOR VARIATIONS

The Spring Azure is an example of a widely distributed species which takes on color variations, from its southernmost to its most northerly range, some broods in the South approximating the Northern forms and others widely varying.

Finally, there is sexual color variation. In the Tiger Swallow-tail one type of female is colored like the male; another type is black (see Color Plate VI, figures 2, 3, and 5); but not a black female can be found in the northern range of this species.

The Dusky Skipper, likewise, has a normally colored female and a black one, and Scudder played a joke on the male of this twin-wife species by christening him the Mormon.

Some species have white or albinic females in addition to the orthodox ones, such as the Clouded Sulphur. And still other species show all the males with one color scheme and all the females with another. The Goatweed Emperor, the Spring Beauty, the Diana Fritillary (see Color Plate II), and the Black Swallow-tail are all examples of this type of color variation.

Both butterflies and moths survive the winter in the egg, as caterpillars, as pupæ, and as adults. Some species pass it in egg form, these eggs usually being covered with a varnish to protect them. Most Swallow-tails pass it as chrysalids, most Angle-wings as adults.

About half the species hibernate as caterpillars, varying from the newly hatched Fritillaries and Graylings, whose only food has been the shells from which they emerged, to the full-grown caterpillars, which pupate in the spring without a mouthful to break their long fast.

Many of the caterpillars construct for themselves highly deceptive and thoroughly ingenious little retreats in which to rest when not eating or in which to spend the winter. For instance, the beautiful Banded Purple inhabits birch trees. Its caterpillar takes a small shoot on a budding birch, makes a shelter from it, and ensconces itself therein. Ichneumon flies buzz about, exploring the tree in search of caterpillars which they can convert into animated larders for their own young.

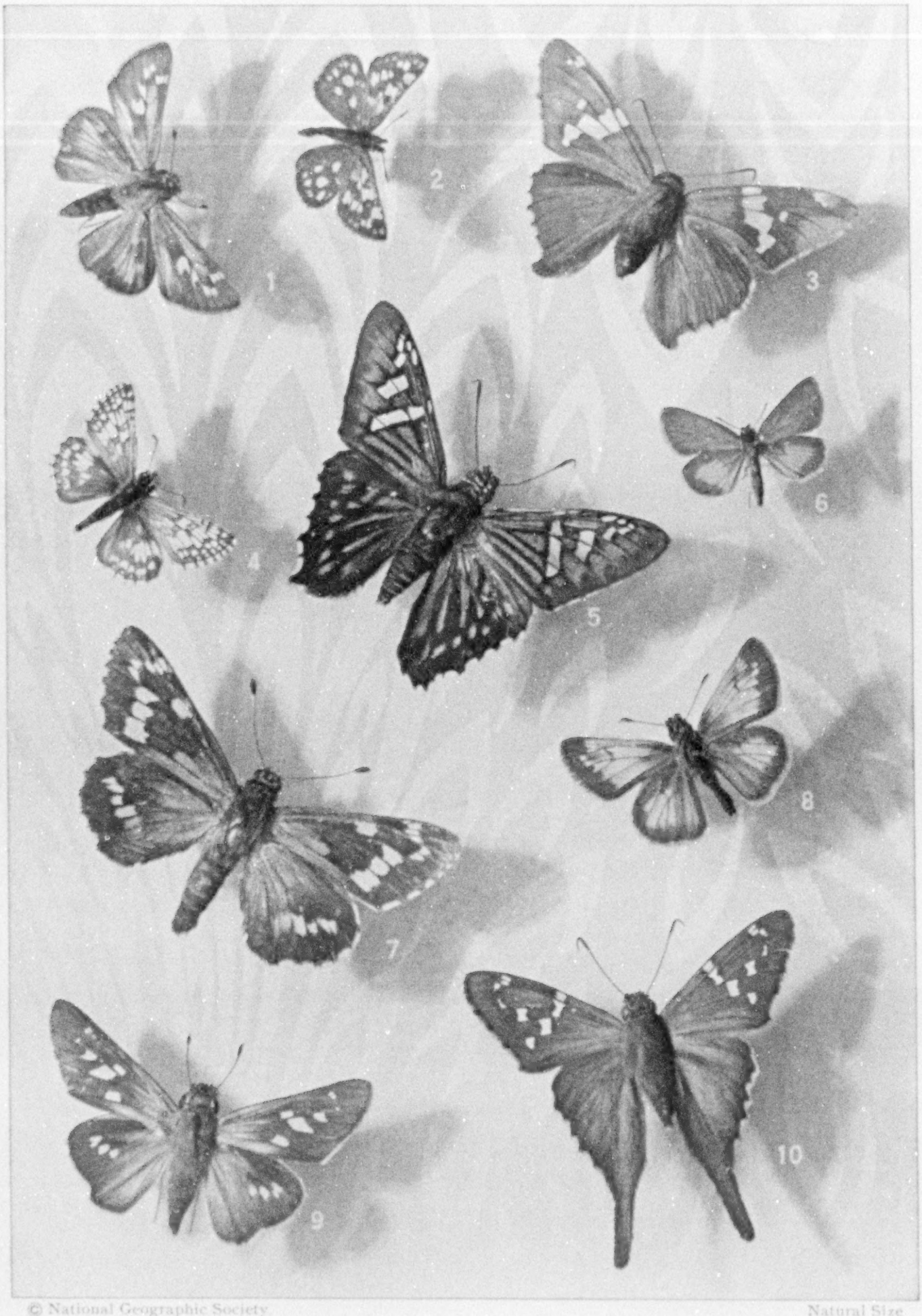
But the Banded Purple's caterpillar does not need to worry a great deal, for its snug little nest looks so like the birch bud that the flies usually fail to penetrate the camouflage.

THE AVERAGE BUTTERFLY'S SPAN OF LIFE IS FOUR OR FIVE WEEKS

How long do butterflies and moths live? is a question often asked. In those species which have atrophied or rudimentary mouth parts it may be assumed that their span of life is necessarily brief. Others live many weeks, and some, it is believed, as much as ten months; but the average life is believed by Scudder to be around four or five weeks.

Some species live long enough even to "follow the swallow" in pursuit of spring. The autumn brood of the Monarch (see Color Plate IX, figure 12), for instance, gather in hordes in the northeastern States, and, their numbers swelling by recruits as they fly onward, finally reach the far south, to winter in lands of sunshine.

Dr. Frank Lutz says that great clouds of Painted Lady butterflies have been seen to land on the Bermuda Islands from the northwest, having covered 600 miles of ocean.



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BEAUTY PRIZE-WINNERS OF THE SKIPPER TRIBE, SO CALLED FROM A PECULIARITY IN FLIGHT

(1) *Atalopedes campestris* Bdv.; (2) Arctic Skipper, *Carterocephalus palaemon* Pall.—also known as *Pamphila palaemon* and *Pamphila mandan*; (3) Silver-spotted Skipper, *Epargyreus tityrus* Fabr.; (4) Tessellated Skipper, *Pyrgus tessellata* Scud.—also known as *Hesperia tessellata* and *Hesperia montivaga*; (5) *Eurycides urania* W. & H.; (6) Least Skipper, *Ancyloxypha numitor* Fabr.; (7) *Megathymus neamoegeni* Edw.; (8) Hobomok Skipper, *Poanes hobomok* Harris—also known as *Atrytone zabulon*; (9) Brazilian Skipper, *Calpodes ethlius* Cram.; (10) Long-tailed Skipper, *Goniurus proteus* L.—also known as *Eudamus proteus*.

The Mourning-cloak (see Color Plate III, figure 7) and some of the Tortoise-shells have also been observed as immigrants at times.

There are a thousand and one wonder stories that might be written about butterflies and moths. That master of butterfly habits, the late S. H. Scudder, wrote a whole volume about the Milkweed Butterflies alone, and yet he admitted that much had been left untold. Perhaps each of the 9,500 species of the scaly-winged order could instruct us as interestingly and to as great length as the Monarchs.

If we should journey to the top of Mount Washington, New Hampshire, we might find a dainty little Fritillary, *Brenthis montinus,* or that other cheery little satyr, *Oeneis semidea* (see Color Plate IX, figure 2), imprisoned on the heights because the weather is too warm below. Both came down out of the Arctic on the crest of the great Ice Age, and when the ice finally receded they were left, Robinson Crusoe fashion, on an island of cold in a sea of warm air.

O. semidea occupies only that section of the mountain above 5,000 feet. It is also found on some of the high peaks of Colorado, whence it came out of the Arctic under conditions similar to those which brought it to Mount Washington. *B. montinus* lives below the forest line in the White Mountains, as *O. semidea* lives above; but it, too, is segregated on an island of cold. These frail little creatures demand for their existence weather so harsh and stormy that even man finds it hard to face.

BUTTERFLIES HAVE PSYCHOLOGICAL PECULIARITIES

Or we might turn aside and note with Scudder the psychological peculiarities of butterflies (he tells us that when he first prepared to write an essay on that subject his friends thought he was "spoofing" them); of butterflies in the Swiss Alps which have no fear of human beings; of Red Admirals (see Color Plate III, figure 3) that seem to delight in barely keeping out of the way of the hunter's net; of combative species, like the American Copper and the Buckeye, that will dart madly, like bees and hornets, at a hat or other object thrown into the air; of other species that play in the air as lambs gambol on the green, with every evidence "of mirth and jocund din."

Again, we might pause to note the tendency of male butterflies to carry sachet bags in their wings to dandify themselves for courting hours; to observe how butterflies are botanists, recognizing the close relatives of their favorite food plants with unerring accuracy; to consider the inexplicable manifestations of instinct that makes the butterfly know the food plants on which its caterpillars feed, although it itself sips nectar from other honey wells.

Then there are such fascinating stories as that of the female Yucca moths, related to our Clothes-moth, upon whom the various species of Yucca are almost entirely dependent for fertilization. These moths not only render an accidental service in transferring pollen from the stamens of one flower to the pistils of another, as do most insects in their nectar-sipping expeditions, but they deliberately, as Professor Riley has demonstrated, collect the pollen in their mouths, which are particularly modified for this task, carry it to the stigma of a flower, and "apply it thereto with infinitely better care than could be done by the most skillful horticulturist, even though he might use the most delicate human appliances."

After this task is finished the moth lays her egg in the seed capsule, upon whose tissues her young will feed.

THE ROMANCE OF BUTTERFLY HUNTING

The story of butterfly and moth hunting is filled with romance. Scientists have climbed the mountains and penetrated the jungles of the earth in their quest of these elusive winged rainbows. Numerous lepidopterists have gone to the Tropics to chase innumerable species and to classify and name them.

At home, too, there have been all kinds of adventures. Holland, who has done so much to stimulate interest in the scaly-winged order, tells us of the time when, as a bashful, barefoot boy, he spied his first Diana Fritillary and gave chase.

Up by a boarding school the fluttering creature led him. At every window was a girlish face, and he the most bashful of boys. But his desire to possess the

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ANIMATED GEMS RANGING FROM SATYR TO MONARCH

(1) *Gyrocheilus patrobas* Hew.; (2) White Mountain Butterfly, *Oeneis semidea* Say; (3) Alaskan Alpine, *Erebia disa* Thun.; (4) Ochre Ringlet, *Coenonympha ochracea* Edw.; (5) Grayling, *Cercyonis alope* Fabr.; (6) Ridings' Satyr, *Neominois ridingsi* Edw.; (7) *Oeneis nevadensis* Feld. [Female]; (8) Little Wood-satyr, *Cissia eurytus* Fabr.; (9) *Oeneis nevadensis* Feld. [Male]; (10) *Lycorea cleobaea* Godt.; (11) Queen, *Anosia berenice* Cram.; (12) Monarch, *Anosia plexippus* L.

graceful insect was greater than his dread of feminine eyes, and even though the village wag cried after him that the butterfly would not let such a homely boy catch her, he did not relent until he had captured his quarry.

WIDE FIELD IS OPEN FOR AMATEUR RESEARCH

Two young women, wanting to know something more about moths, converted one of their rooms into a "crawlery," where they could watch microscopic caterpillars hatch out of tiny eggs, grow, molt, make cocoons, and finally emerge therefrom as beautiful moths. And from these observations resulted one of the most delightful books in the whole field of natural history.

While tremendous progress has been made in the study of moths and butterflies, there is still opportunity for careful, accurate observation of hundreds of species that dwell in every community, and there remain many gaps to be filled before the story is complete.

The great museums of the world have gathered large collections and individual collectors possess many notable ones.

Occasionally one of these collections goes upon the market for one reason or another, but usually when they pass out of private hands they are presented to such institutions as the United States National Museum, the American Museum of Natural History, and the British Museum; for the creators of these fine individual collections usually are too devoted to their specimens to place a money value upon them. One collector I know is a worker in one of America's greatest museums. He wears cotton socks bought at the 10-cent store, so that he may save money with which to buy specimens for the museum for which public funds are not available.

WHERE OUR MOTHS AND BUTTERFLIES ROAM

THE reproductions of the 16 butterfly and moth plates in four colors, published in this number of the NATIONAL GEOGRAPHIC MAGAZINE, were made possible through the coöperation of the United States National Museum and Dr. Harrison G. Dyar, whose work in the classification of Lepidoptera has been an outstanding achievement in the activities of this great institution.

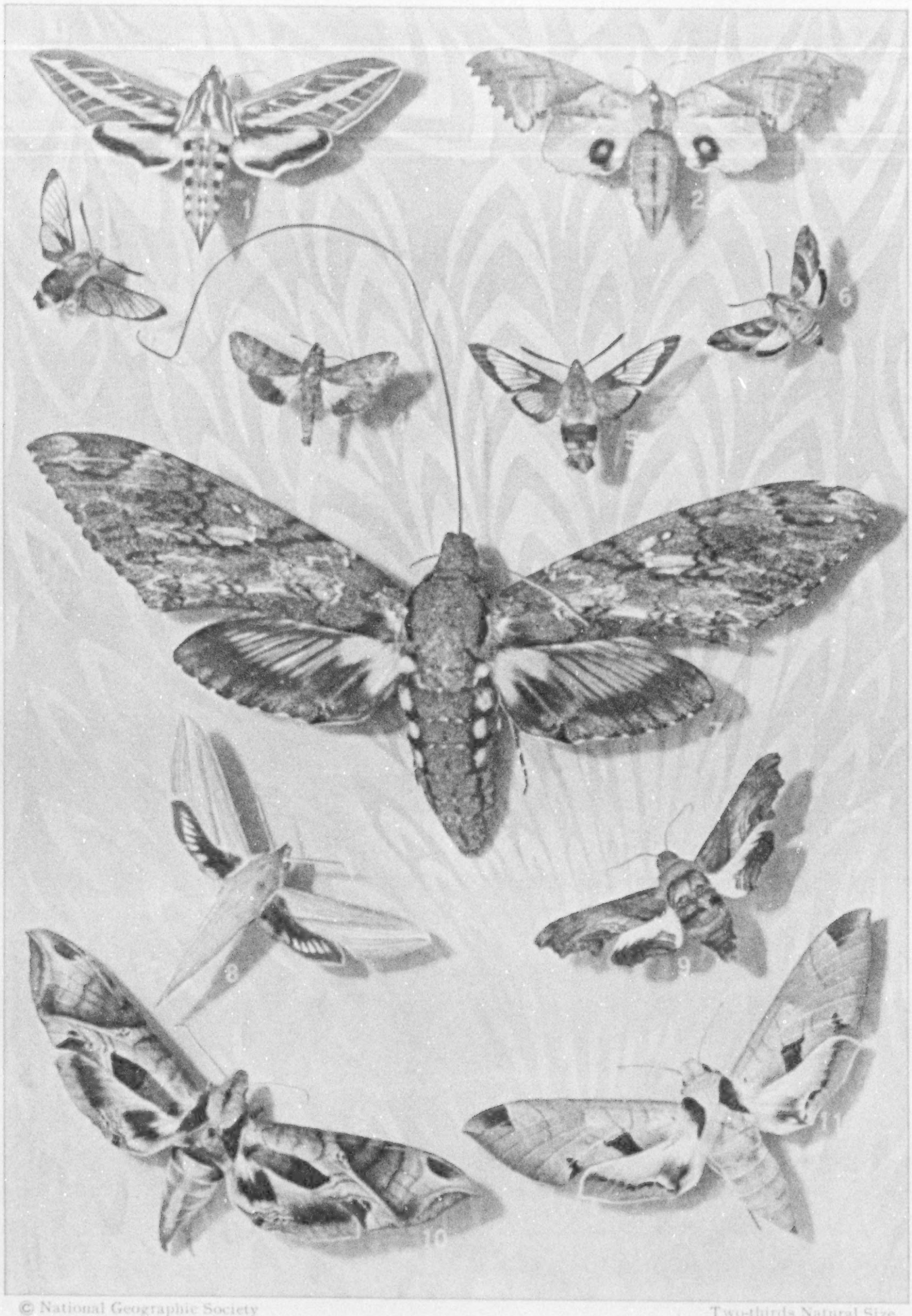
The photographic staff of the National Geographic Society worked out an entirely new system of furnishing the engraver with the color values of the specimens, through which one entire stage in color reproduction was eliminated and consequent loss of color value overcome.

The butterflies and moths here reproduced were selected to show at once the wide range of beautiful color patterns and to aid the everyday reader in becoming better acquainted with the fragile creatures of the air about us. These illustrations present a cross-section of the lepidopterous life of North America, with a few touches of the brilliant tropical life that is always a challenge to color reproduction.

In technical nomenclature the most recent practice has been to subdivide the butterflies into 13 families. Most of the popular field and reference books, however, still adhere to an older classification of five or six families. Lutz and Holland group them into five, and Kellogg into six. Holland and Lutz put the Whites, Sulphurs, and Orange-tips into the family of the Papilionidae with the Swallow-tails, while Kellogg places them in a separate family, called the Pieridae.

Among the moths there are many families—43, according to Holland—but those most frequently observed are the Sphingidae, the Noctuidae, the Arctiidae, the Lithosiidae, the Ceratocampidae, and the Saturniidae. Here, again, different authorities assign various groups to different families.

In these pages the classifications of Lutz and Holland have been followed, as typical of the field books available to the lay reader who wishes to learn something at first hand about the fascinating folk of the moth and butterfly world.



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Two-thirds Natural Size

AMONG SPHINX MOTHS THE GIANT COMMANDS ATTENTION FOR ITS SIZE AND TONGUE

(1) Striped Morning Sphinx, *Celerio lineata* Fabr.; (2) Blinded Sphinx, *Paonias excaecata* A. & S. —also known as *Calasymbolus excaecatus;* (3) Snowberry Clear-wing, *Haemorrhagia diffinis* Bdv.; (4) *Cautethia noctuiformis* Walk.; (5) Humming-bird Clear-wing, *Haemorrhagia thysbe* Fabr.; (6) Clark's Day-sphinx, *Proserpinus clarkiae* Bdv.; (7) Giant Sphinx, *Cocytius antaeus* Dru.; (8) Tersa Sphinx, *Xylophanes tersa* L.; (9) Abbot's Sphinx, *Sphecodina abbotti* Swains.; (10) Satellite Sphinx, *Pholus satellitia* Dru.; (11) Achemon Sphinx, *Pholus achemon* Dru.

Diana Fritillary (*Argynnis diana* Cram. Plate II, figures 1 and 2).—This well-known species belongs to the southern Appalachian region, with a range extending from Virginia and West Virginia to Georgia and South Carolina and westward to the Ozarks, being found in small numbers in southern Ohio and Indiana. The males and females have different markings, as the Plate shows.

Chlosyne lacinia Gey. (Plate II, figure 3).—This species is found occasionally in Texas, Arizona, and Mexico. It belongs to the same general group as the Buckeyes, Wandering Commas, and Crimson-patches.

Heterochroa bredowi Hbn. (Plate II, figure 4).—The range of this species is southern California and Arizona. It is closely related to some of the European butterflies. The larvæ feed on oak.

Euphydryas anicia Dbldy. & Hew. (Plate II, figure 5).—This butterfly, which lacks a common name, is found in the Rocky Mountains and the Pacific States. It is a close relative of our Eastern species, the Baltimore.

Compton Tortoise (*Aglais j-album* Bdv. & Le Con.—also known as *Vanessa j-album*. Plate II, figure 6).—This fair representative of the Tortoise-shell group of butterflies is found from Pennsylvania to Labrador in the East and to Alaska in the Northwest. Its larvæ feed upon willows.

Viceroy (*Basilarchia archippus* Cram. Plate II, figure 7).—The Viceroy gets its everyday name from the fact that it imitates the Monarch. It is found all over the United States as far west as the Sierra Nevada, and sparingly even to the north Pacific coast. The species has two families a year in the northern part of its range. The caterpillar of the autumn brood, when half grown, rolls a leaf, ties it fast to a twig with silk, and then makes a silk couch therein, in which it spends the winter. It feeds on the willow, poplar, aspen, and cottonwood. The Viceroy's mimicry of the Monarch, *Anosia plexippus* (see Color Plate IX, figure 12), affords a striking example of protection by imitation.

Melitaea neumoegeni Skin. (Plate II, figure 8).—This butterfly is found in the mountains of southern California and in the Death Valley region. It belongs to the Checker-spot tribe, and its coloring departs from that of its closer relatives, which inhabit more colorful areas, and is as drab as the region it frequents.

Portia Butterfly (*Anaea portia* Fabr.—also known as *Pyrrhanaea portia*. Plate II, figure 9).—This essentially tropical species occasionally wanders into the southern part of Florida. It is closely related to the Goat-weed Butterfly.

Vanessa carye Hbn. (Plate II, figure 10).—This is a Pacific coast butterfly of the Tortoise-shell group. Its caterpillars live upon malva, hollyhocks, and low ground plants.

Leto Fritillary (*Argynnis leto* Behr. Plate III, figures 1 and 2).—The males and females of this beautiful species have different markings and range the Pacific slope. The Leto is closely related to the Great Spangled Fritillary of the East. The larvæ feed on violets.

Red Admiral (*Vanessa atalanta* L. Plate III, figure 3).—A thorough-going cosmopolite, the Red Admiral is found alike in Europe, Asia, and North America, reaching as far south as Cuba and Guatemala. Its food plants include the nettle and the hop. This butterfly winters both as a chrysalis and as an adult, and the frayed, worn appearance of the latter is in painful contrast to the spick-and-span aspect of that which spends the winter as a chrysalid.

Gulf Fritillary (*Dione vanillae* L. Plate III, figure 4).—The range of this species is from southern Virginia south and westward to Florida and California. Its food plant is the passion-flower. It has a wing-spread of about three inches.

Buckeye (*Junonia coenia* Hbn. Plate III, figure 5).—The Buckeye appears to be the only species of its genus which ventures outside the Tropics; its range extends from Cuba to Massachusetts and westward to the Pacific coast. In warmer areas there are three to four generations a year; in New England only one, and this hibernates as a butterfly. It loves the open fields, and its larvæ feed mainly on plantains and members of the figwort family. It is rather saucy and impudent to other butterflies.

Delila (*Colaenis delila* Fabr. Plate III, figure 6).—The Delila Butterfly is a tropical species which has ventured as far north as southern Texas.

Mourning-cloak (*Aglais antiopa* L.—also known as *Vanessa antiopa*. Plate III, figure 7).—This species is known to nearly every lover of the out-of-doors in the North Temperate Zone. In England its popular name is the Camberwell Beauty. It is the largest of our butterflies which hibernate as adults. When the midwinter thaws occur, one is likely to see in open glades several dark-colored butterflies flitting from tree to tree or resting with expanded wings in sunny spots. These are Mourning-cloaks which have ventured out of their winter retreats, perhaps to die victims of the ensuing cold weather. The eggs are laid in masses circling the twigs of elms, willows, and poplars in late spring, and hatch in about two weeks.

Wandering Comma (*Polygonia satyrus* Edw. Plate III, figure 8).—This species deserves its name as a wanderer. It is found in the Rocky Mountains as far south as New Mexico, and westward to the Pacific from Santa Clara County, California, to Vancouver, British Columbia. It has also been found in Canada—in Ontario, around Montreal and Ottawa—and in Lewis County, New York. Its larvæ feed on stinging nettles.

Regal Fritillary (*Argynnis idalia* Dru. Plate III, figure 9).—Fresh from its pupal case, this lovely member of the Fritillary tribe shows a brilliant sheen of iridescence. It possesses a rather plump body and a wing-spread of about three inches. Having only one generation a year, each stage from egg to adult is more than usually long. Its range is from New England

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THE HAWKMOTHS COMPRISE A BRILLIANT WINGED FAMILY

(1) Five-spotted Hawkmoth, *Protoparce quinquemaculata* Haw.; (2) Big Poplar Sphinx, *Pachysphinx modesta* Harr.; (3) Hydrangea Sphinx, *Ampeloeca versicolor* Harr.—also known as *Darapsa versicolor;* (4) Lettered Sphinx, *Deidamia inscripta* Harr.; (5) *Pholus typhon* Klug.; (6) Nessus Sphinx, *Amphion nessus* Cram.; (7) *Erinnyis caicus* Cram.; (8) Hog Sphinx, *Ampeloeca myron* Cram.—also known as *Darapsa myron;* (9) Alope Sphinx, *Erinnyis alope* Dru.; (10) Lesser Vine Sphinx, *Pholus fasciatus* Sulz.

to Nebraska, in the belt characterized by 50° Fahrenheit as the mean annual temperature. The eggs are laid on the under side of violet leaves, upon which its caterpillars feed, although the butterfly itself is partial to the nectar of joe-pye-weed, boneset, goldenrod, ironweed, and swamp milkweed.

Crimson-patch (*Synchloe janais* Dru. Plate III, figure 10).—This species is largely a tropical one. The northern limits of its habitat reach no farther than Texas, and it is more abundant in Mexico and Central America.

Orange Sulphur (*Eurymus eurytheme* Bdv. Plate IV, figures 1, 2, and 3).—The Orange Sulphur is essentially western in its habitat, though it has been noted in the region of Vancouver in the West, and the valley of the St. Lawrence in the East. The southern limits of its range extend from southern California to Mississippi. It is one of the butterflies which has females of two different types, as shown in the Color Plate.

Cloudless Sulphur (*Catopsilia eubule* L. Plate IV, figures 4 and 5).—The range of this species is from New England and Wisconsin to Patagonia. The region of its greatest abundance is tropical America, where it congregates in great swarms along streams. Other favorite haunts are the orange groves of Florida and Latin America. It will be noted that in the Cloudless Sulphur the female has different markings from the male.

Orange-tip (*Anthocharis sara* Bdv. Plate IV, figure 6).—A true Westerner is this species, belonging to the Mountain States of the Pacific coast. Its early stages appear still to be unknown.

Large Orange Sulphur (*Catopsilia agarithe* Bdv. Plate IV, figure 7).—This species occurs along the shores of the Gulf of Mexico and throughout tropical America. It is closely related to the more familiar Cloudless Sulphur (see figures 4 and 5).

Cabbage Butterfly (*Pieris rapae* L. Plate IV, figure 8).—This species is an imported pest. It appears to have been first introduced into Quebec about 1860 and around New York about 1868. Within 30 years of the time of its introduction it has established itself all over the United States and Canada. Its coming has led to the practical extinction of two native species, the Gray-veined White and the Checkered White, both of which formerly fed on cabbage.

Dog's-head Butterfly (*Zerene caesonia* Stoll.—also known as *Meganostoma caesonia*. Plate IV, figure 9).—This is another species belonging to the tribe of the Yellows. It gets its name from the markings on its wings, which are supposed to resemble a dog's head, although some insist that it looks more like a duck. The range of the species is from Pennsylvania and southern Wisconsin to the Gulf States and Central America, and the food plants of its caterpillars are false-indigo and clover.

Zerene Dog's-head Butterfly (*Zerene eurydice* Bdv. Plate IV, figures 10 and 13).—This is a Pacific coast species whose habits are essentially the same as those of the species immediately preceding.

Clouded Sulphur (*Eurymus philodice* Godt. Plate IV, figure 11).—Everybody knows this species, since no eye is so unobservant as not to have noticed great groups of them holding their little banquets around mud puddles in the road. If one examines the border of the puddle carefully after the butterflies have flown, he will discover the mud full of pinholes where the thirsty creatures have thrust their tongues. The Clouded Sulphur loves the sun. If heavy clouds obscure it, the thousands of butterflies hasten to hide beneath clover or down in the grasses in which they spend the night. Its range is from the mouth of the St. Lawrence River to South Carolina and westward to the Rocky Mountains. There are two forms of the female, the one substituting white where the other wears yellow.

Eurema proterpia Fabr. (Plate IV, figure 12).—Mexico is the usual habitat of this butterfly, though it occasionally crosses the Rio Grande into Texas.

Blue Swallow-tail (*Papilio philenor* L. Plate V, figure 1).—During the summer months this butterfly is found in the Middle Atlantic States. It ranges from Massachusetts to Arizona and southward into Mexico. The caterpillar feeds upon the leaves of the Dutchmans-pipe and Virginia snakeroot.

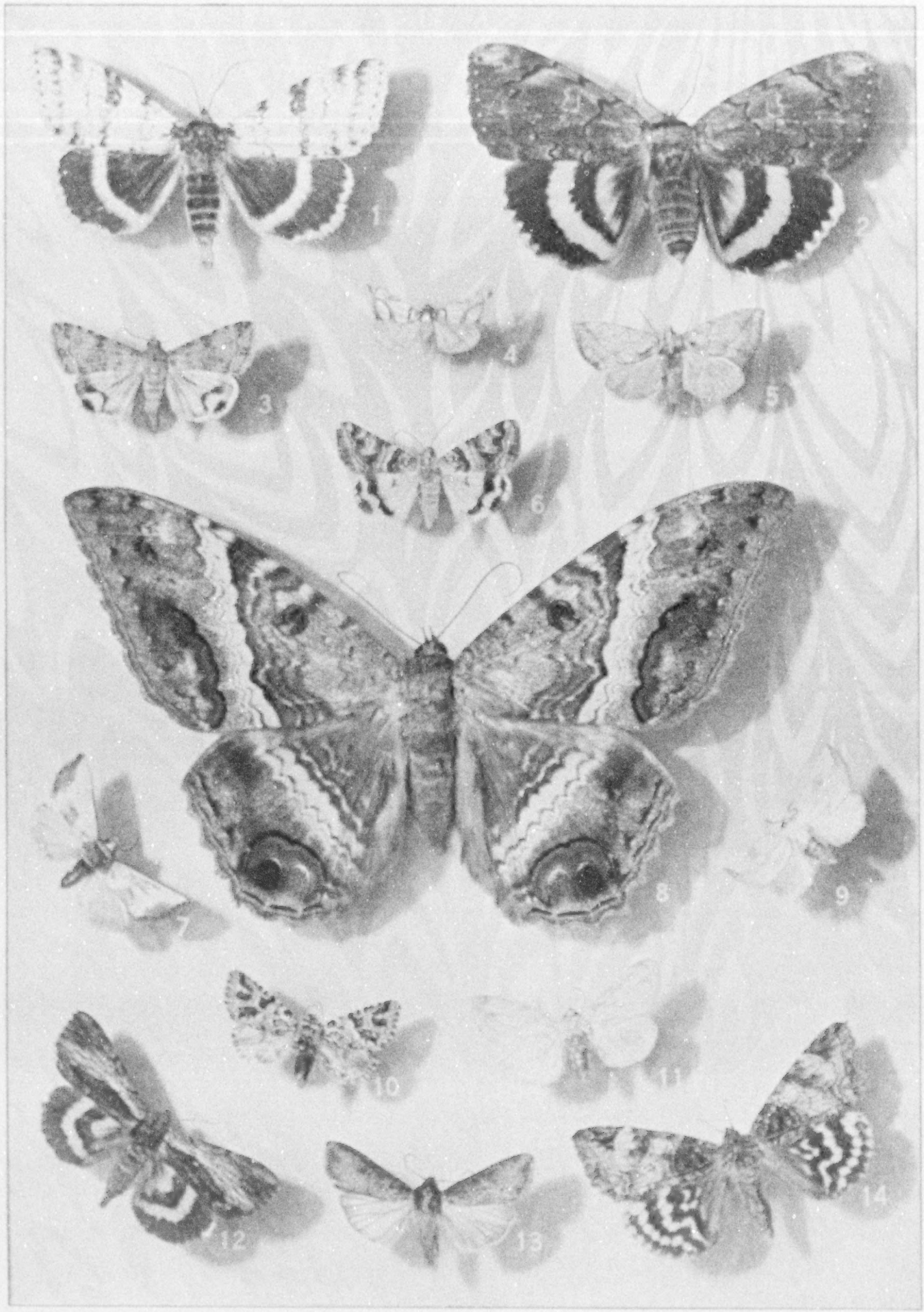
Zebra Swallow-tail (*Papilio marcellus* Cram.—also known as *Iphidicles ajax marcellus*. Plate V, figure 2).—This early spring form is found almost everywhere in the eastern part of the United States, where its caterpillars can find their favorite food, the papaw. It ranges as far north as southern Michigan and in the South passes down to Florida.

Black Swallow-tail (*Papilio polyxenes* Fabr., form *americus* Koll. Plate V, figure 3; form *asterius* Cram., figures 5 and 6).—This butterfly is the adult of the well-known striped parsnip worm and is found generally throughout the eastern United States. The male and female are different in coloration. The form *americus* is a local race from Arizona and Mexico in which the yellow markings are broader.

Giant Swallow-tail (*Papilio cresphontes* Cram. Plate V, figure 4).—While a native of the South, this species is now spreading northward and has been found in Ontario. The orange growers of Florida consider its caterpillar a pest and complain of its ravages upon their trees. The larva is called the "orange dog."

Papilio mylotes Bates. (Plate VI, figures 1 and 6).—This species belongs to a large group of brilliant butterflies the center of whose habitat is the Amazon Valley. Occasional members of the species wander as far north as our Gulf coast.

Tiger Swallow-tail (*Papilio glaucus* L. Plate VI, figure 2; form *glaucus*, figure 3; form *turnus*, figure 5).—On the basis of its wide distribution, the Tiger Swallow-tail would make a lively candidate for our national butterfly. Although its metropolis appears to be in the wooded



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THE MOTH'S CONCEALED BEAUTY IS REVEALED TO THE COLLECTOR (SEE TEXT PAGE 88)

(1) White Birch Under-wing, *Catocala relicta* Wlk.; (2) Darling Under-wing, *Catocala cara* Gn.; (3) *Cirrhobolina mexicana* Behr.; (4) *Chalcopasta koebelei* Riley; (5) *Basilodes pepita* Gn.; (6) *Syneda hastingsi* Edw.; (7) *Stiria rugifrons* Grt.; (8) *Erebus odora* L. [Female]; (9) *Thurberiphaga diffusa* Barn.; (10) *Momophana comstocki* Grt.; (11) *Cirrhophanus triangulifer* Grt.; (12) Ultronia Under-wing, *Catocala ultronia* Hbn.; (13) Variegated Cutworm Moth, *Peridroma margaritosa* Haw.; (14) Clouded Locust Under-wing, *Euparthenos nubilis* Hbn.

forests of the Appalachian Mountains, its range extends from Canada to Key West and the Rio Grande. It affords an example of that form of dimorphism in which females hatched from the same lot of eggs take different colors, although the males always adhere to the one form. The caterpillars, having heads resembling those of serpents (see text, page 91), are found on a great variety of trees and shrubs, including tulip trees, birches, wild cherries, apples, poplars, and ashes.

Parnassian Butterfly (*Parnassius smintheus* Dbldy. & Hew. Plate VI, figure 4).—The Parnassians are Alpine or arctic in habitat. *P. smintheus* is found in the high mountain regions from New Mexico to Montana and thence to the Pacific coast. The caterpillars resemble those of *Papilios*, but are darkly colored and are found wandering on the ground amid the scanty vegetation of their Alpine abode.

Heodes cupreus Edw. (Plate VII, figure 1).—This species is found in dry country, its favorite habitat being eastern Oregon and Wyoming.

Atala (*Eumaeus atala* Poey. Plate VII, figure 2).—This Southern form is found only sparingly in Florida and Cuba. The larva feeds on zamia, one of the few remaining cycads of the Coal Age. The butterflies are all tame and may be hand picked from flowers with a little care.

Wanderer (*Feniseca tarquinius* Fabr. Plate VII, figure 3).—This little Copper is found all over the Atlantic States from Nova Scotia to the Carolinas. It also inhabits the Mississippi Valley. There is but the one species of this genus known. The larva feeds on the masses of white bark-lice found on alder bushes, greatly reducing the numbers of the lice. This is our only carnivorous butterfly.

Great Purple Hair-streak (*Atlides halesus* Hbn.—also known as *Thecla halesus*. Plate VII, figure 4).—The Great Purple Hair-streak is our largest Hair-streak species. It is very common in Central America and Mexico. Although a tropical form, it extends from California to Florida and occasionally occurs as far north as southern Illinois. Its larvæ feed on the mistletoe growing on oaks.

Hypaurotis crysalus Edw. (Plate VII, figure 5).—This is a Western butterfly. It is found generally in California, Utah, and Arizona.

Philotes sonorensis Feld. (Plate VII, figure 6).—This is a Southern butterfly whose range includes southern California and Mexico. It is prized for the curious red markings, so exceptional in one of the Blues.

Bronze Copper (*Heodes thoe* Bdv.—also known as *Chrysophanus thoe*. Plate VII, figures 7, 9, and 10).—This is a rare insect although it occurs in northern Illinois, Nebraska, Iowa, and the upper Mississippi Valley. It has two families a year, and winters as an egg. It finds both goldenrod and Canada thistle much to its liking.

Glaucopsyche lygdamus Dbldy. (Plate VII, figure 8).—Although the exact range of this silvery blue butterfly is not known, it has been found in the Atlantic States from the upper waters of the Susquehanna to Georgia. In its northern range it reaches westward to Ohio, Michigan, and Wisconsin.

Strymon martialis H. S. (Plate VII, figure 11).—The range of this butterfly is very limited; it is found only in southern Florida and the Antilles.

American Copper (*Heodes hypophlaeas* Bdv. Plate VII, figure 12).—These little butterflies are found in the Atlantic States. In the northern part of their range they are double-brooded, and in the southern part triple-brooded. It winters as a chrysalis. It is sorrel in color, matching the sorrel on which it feeds.

Strymon acis Dru. (Plate VII, figure 13).—Southern Florida is the favorite haunt of this butterfly.

Atalopedes campestris Bdv. (Plate VIII, figure 1).—This butterfly was first found by Boisduval in California. Some authorities have considered it identical with, or at least a variety of, the Sachem or Velvet-spotted Skipper, *Atalopedes huron*, but Scudder declared that the specimens he examined would not permit of such a conclusion. At any rate, it is a very close relative of the Sachem, which ranges from the Catskills of New York to Florida and westward. Its larvæ feed on Bermuda grass, fastening together a number of blades and spinning in the cylindrical cavity thus formed silken webs which serve as retreats, from which they emerge only when feeding.

Arctic Skipper (*Carterocephalus palaemon* Pall.—also known as *Pamphila palaemon* and *Pamphila mandan*. Plate VIII, figure 2).—The range of this butterfly extends from southern Labrador south to the White Mountains and the Adirondacks, and thence westward to the summits of the Sierras in northern California and to southeastern Alaska. Its caterpillars feed on grasses.

Silver-spotted Skipper (*Epargyreus tityrus* Fabr. Plate VIII, figure 3).—The range of the Silver-spotted Skipper reaches from Quebec to Vancouver and as far south as the Isthmus of Panama. It has one generation annually in the North, and is double- or even triple-brooded in the South and within the Tropics. The caterpillar feeds on leguminous plants and is especially fond of wisteria and the locust tree.

Tessellated Skipper (*Pyrgus tessellata* Scud. —also known as *Hesperia tessellata* and *Hesperia montivaga*. Plate VIII, figure 4).—This, one of the commonest of the southern Hesperids, claims the whole of the United States for its range. Its caterpillars feed on hollyhocks, Indian mallows, and related plants.

Eurycides urania W. & H. (Plate VIII, figure 5).—This beautiful butterfly is a tropical species, but on rare occasions individuals have been found within the southern borders of the United States.

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FROM THE SHOWY TIGER-MOTHS TO THE FALL WEB-WORM, THIS GROUP RUNS THE GAMUT IN HABIT AND HABITAT

(1) Mexican Tiger-moth, *Apantesis proxima* Guer.; (2) Leopard-moth, *Ecpantheria deflorata* Fabr.; (3) Beautiful Utetheisa, *Utetheisa bella* L.; (4) Acraea Moth, *Estigmene acraea* Dru. [Female]; (5) Colona Moth, *Haploa colona* Hbn.; (6) Big Halisidota, *Halisidota ingens* H. Edw.; (7) Spotted Halisidota, *Halisidota maculata* Harr.; (8) St. Lawrence Tiger-moth, *Hyphoraia parthenos* Harr.; (9) Acraea Moth, *Estigmene acraea* Dru. [Male]; (10) Painted Arachnis, *Arachnis picta* Pack.; (11) Virgin Tiger-moth, *Apantesis virgo* L.; (12) Showy Holomelina, *Eubaphe ostenta* Hy. Edw.—also known as *Holomelina ostenta*; (13) Isabella Tiger-moth, *Isia isabella* A. & S.; (14) Crimson-bodied Lichen-moth, *Lerina incarnata* Bdv.; (15) Milk-weed Moth, *Euchaetias egle* Dru.; (16) Ranchman's Tiger-moth, *Platyprepia virginalis* Bdv.; (17) Fall Web-worm Moth, *Hyphantria cunea* Dru.; (18) *Arctia americana* Harr.

Least Skipper (*Ancyloxypha numitor* Fabr. Plate VIII, figure 6).—The smallest of the Skippers is different both in habit and structure from its cousins of the tribe. It is slender-bodied where they are plump and when resting it has a manner of twirling in opposite directions alternately its two antennæ. The eggs are laid in the grass and the butterfly usually floats slowly just above the herbage in sunny places in wet meadows and along the open margins of brooks and marshes. The range of the species extends from Quebec to Florida and westward to the Rocky Mountains.

Megathymus neumoegeni Edw. (Plate VIII, figure 7).—This species has been found in Arizona and Mexico. It is closely related to *M. yuccae*, which is found rather generally distributed in the Southern States. The larvæ bore into the roots and stems of yucca.

Hobomok Skipper (*Poanes hobomok* Harris —also known as *Atrytone zabulon*. Plate VIII, figure 8).—This species ranges from New England to Georgia and westward to the Great Plains, being very common in Pennsylvania and Virginia and along the Ohio River.

Brazilian Skipper (*Calpodes ethlius* Cram. Plate VIII, figure 9).—The Brazilian Skipper might be called a guest from the Tropics, as its southern range reaches to Argentina. It occurs as far north as South Carolina, is abundant around the Gulf of Mexico, and there is a record that one individual was taken some years ago in New York State. Almost every year we find some of the larvæ on the ornamental cannas in Washington, D. C. Its powers of flight must be considerable, as it is killed off every winter in the North.

Long-tailed Skipper (*Goniurus proteus* L.—also known as *Eudamus proteus*. Plate VIII, figure 10).—This is another tropical species which has ventured into the temperate regions and is found occasionally as far north as New York City. Its caterpillar feeds on wisteria and the butterfly-pea, beans, etc., cutting a flap out of the corner of a leaf which it folds over and fastens with a few strands of silk.

Gyrocheilus patrobas Hew. (Plate IX, figure 1).—This species is found in Mexico and Arizona. It is a close relative of the Arizona Blackamoor, *G. tritonia*, which has the same general range.

White Mountain Butterfly (*Oeneis semidea* Say. Plate IX, figure 2).—As pointed out in the text on page 103, this butterfly has a remarkably restricted habitat in the United States, appearing only on the summit of Mt. Washington. It is a survival of the Ice Age in those regions, and reaches the lower areas only in Labrador and the far North. Another colony has been left on Mt. Katahdin, Maine, differing a little in color from those on Mt. Washington.

Alaskan Alpine (*Erebia disa* Thun. Plate IX, figure 3).—The Alaskan Alpine is found in Alaska and on the mountains of British Columbia. Its larval stage has not been discovered.

Ochre Ringlet (*Coenonympha ochracea* Edw. Plate IX, figure 4).—The Ochre Ringlet has a range extending from British Columbia to Arizona and reaching as far east as Kansas. Although a small butterfly, it belongs to a genus that is widely distributed throughout the temperate regions of both the New and the Old World. It is often seen flying in dry herbage, which its colors simulate.

Grayling (*Cercyonis alope* Fabr. Plate IX, figure 5).—This species occurs from the Atlantic to the Pacific and has several varieties, among them the Blue-eyed, the Dull-eyed, the Hybrid, and the Sea-coast Graylings. The blue-eyed variety is a lover of lonely lanes and bramble-covered walls and fences as well as of the open woods. It visits the hardhacks in the East and the tickseed on the plains of the West. Its caterpillar hibernates without eating after hatching. The dull-eyed variety is simply a Northern variation of the blue-eyed. Comstock describes the Hybrid Graylings as the progeny of the yellow-banded beauty of the South and the sad-colored Puritan of the North.

Ridings' Satyr (*Neominois ridingsi* Edw. Plate IX, figure 6).—Ridings' Satyr is found in the Mountain States of the Pacific coast. Its eggs are somewhat barrel-shaped, broader at the base than at the top, and with a rounded summit.

Oeneis nevadensis Feld. (Plate IX, figures 7 and 9).—This species occurs in the Pacific States, the male and female differing somewhat in appearance, as is shown in the Color Plate. It is an inhabitant of the higher hills.

Little Wood-satyr (*Cissia eurytus* Fabr. Plate IX, figure 8).—The Little Wood-satyr is one of the most vivacious species of the genus to which it belongs. It loves the shades of thickets and groves. A peculiar thing about its eye spots is that when looked at directly from above they seem solid, but when looked at from an angle they show double pupils of metallic sheen. The species is single-brooded and puts in an early spring appearance. Its caterpillars feed by night and hide during the day among the roots and bases of grass.

Lycorea cleobaea Godt. (Plate IX, figure 10).—This species is essentially a tropical one which occasionally reaches as far north as southern Florida. Its brilliant colors are mimicked in the Tropics by the delicate Heliconias.

Queen (*Anosia berenice* Cram. Plate IX, figure 11).—*Anosia berenice* is a Southern species with a range that includes the Gulf States, New Mexico, and Arizona. The Vice-reine imitates the Queen just as the Viceroy copies the Monarch. The caterpillars are found on a climbing milkweed.

Monarch (*Anosia plexippus* L. Plate IX, figure 12).—The Monarch is one of the world's greatest butterfly travelers. With the advent of spring it presses northward from the Far South until it reaches the latitude of lower Canada. In the fall the northern clans gather and press southward, calling millions of recruits to their standards as they go, until the swarming hosts literally cover the trees upon which they rest during the night. It has crossed the seas, following the trade routes, and has succeeded in

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Two-thirds Natural Size

THE ROYAL WALNUT-MOTH, THE IMPERIAL MOTH, AND SOME OF THEIR SMALL COUSINS

(1) *Adelocephala isias* Bdv.; (2) White-lined Syssphinx, *Adelocephala albolineata* G. & R.—also known as *Syssphinx albolineata;* (3) Honey-locust Moth, *Adelocephala bicolor*, Harr.; (4) Royal Walnut-moth, *Citheronia regalis* Fabr.; (5) Rosy Maple-moth, *Anisota rubicunda* Fabr. [Male]; (6) Orange-striped Oak-worm Moth, *Anisota senatoria* A. & S.; (7) Rosy Maple-moth, *Anisota rubicunda* Fabr. [Female]; (8) Imperial Moth, *Eacles imperialis;* Dru.—also known as *Basilona imperialis;* (9) Heiligbrodt's Syssphinx, *Adelocephala heiligbrodti* Harv.—also known as *Syssphinx heiligbrodti;* (10) Stigma Moth, *Anisota stigma* Fabr. [Male]; (11) Stigma Moth, *Anisota stigma* Fabr. [Female].

establishing itself in Australia, Java, Sumatra, and the Philippines. Likewise, it has gained a foothold in England and the Cape Verde Islands. It has traveled across the seas probably as a stowaway in the chrysalis stage, in packing material. The larva is the common striped milkweed caterpillar with its shaking black horns.

Striped Morning Sphinx (*Celerio lineata* Fabr. Plate X, figure 1).—The range of the Striped Morning Sphinx, which is probably the commonest of all the North American sphinx moths, extends from southern Canada to Cuba and Central America. The moth flies in the sunshine and is frequently found swarming around electric street lights in the evening. The caterpillars feed upon the various species of the purslane family, including the flame flower, the Virginia springbeauty, and the ordinary purslane of the garden. The moths visit the blossoms of thistles and of the soapwort in their search for nectar.

Blinded Sphinx (*Paonias excaecata* A. & S.—also known as *Calasymbolus excaecatus*. Plate X, figure 2).—The range of this species extends from southern Canada to Florida and westward to the Great Plains. Its caterpillars feed upon the willow, hazel, ironwood, and other allied trees and shrubs.

Snowberry Clear-wing (*Haemorrhagia diffinis* Bdv. Plate X, figure 3).—This species has a range that extends from New England to Georgia and westward to the Dakotas and Oklahoma. It occurs in three forms, one in the spring and two in the summer. Its caterpillars feed upon snowberries, honeysuckles, and the like.

Cautethia noctuiformis Walk. (Plate X, figure 4).—This is a tropical species, and although it has been seen in southern Florida, it only occasionally comes farther north than Cuba.

Humming-bird Clear-wing (*Haemorrhagia thysbe* Fabr. Plate X, figure 5).—The Humming-bird Clear-wing is the largest and commonest species of the genus to which it belongs. Its caterpillars feed upon viburnum and kindred plants, and the insect's range reaches from Nova Scotia and Canada to Florida and the Mississippi River.

Clark's Day-sphinx (*Proserpinus clarkiae* Bdv. Plate X, figure 6).—Clark's Day-sphinx has a range that extends from Utah and Montana northward into northern California and Oregon.

Giant Sphinx (*Cocytius antaeus* Dru. Plate X, figure 7).—The Giant Sphinx, famous for its magnificent tongue, has a range that extends from Florida into southern Brazil. The larvæ are large green worms with a horn near the tail, feeding upon plants of the custard-apple family.

Tersa Sphinx (*Xylophanes tersa* L. Plate X, figure 8).—This species is a common and easily recognized one, possessing a range that extends from southern Canada to northern Argentina. Its peculiar tapering body gives it a graceful appearance.

Abbot's Sphinx (*Sphecodina abbotti* Swains. Plate X, figure 9).—This, one of the beauties of the Hawkmoth group, has a range that extends throughout the Eastern States and southern Canada and as far westward as Iowa and Kansas. The larvæ occur in two forms, one with large green moon-shaped spots, the other plain brown, and are found on woodbine and grape.

Satellite Sphinx (*Pholus satellitia* Dru. Plate X, figure 10).—The Satellite Sphinx is widely distributed throughout the eastern United States and southern Canada. During the first several molts the caterpillar is green. In the later stages of development it frequently becomes dark brown. The genus to which the Satellite belongs embraces 19 species. The caterpillars have the body large in front, into which they can draw the head. They are red or green, with white spots on the sides, and occur on the woodbine and grape.

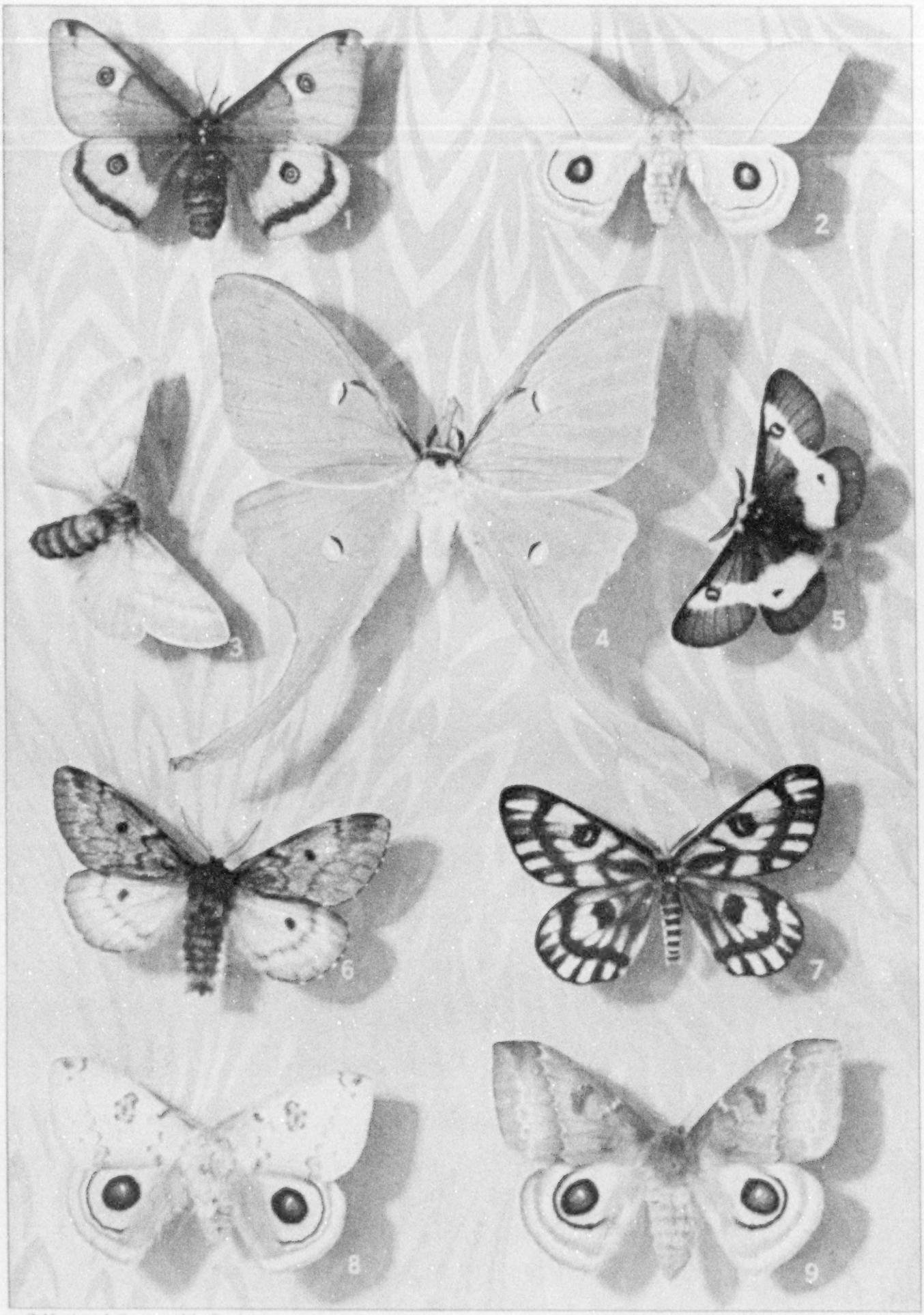
Achemon Sphinx (*Pholus achemon* Dru. Plate X, figure 11).—The Achemon Sphinx has a range that includes all of the United States, southern Canada, and the northern part of Mexico. Its caterpillars feed upon vines and show a special fondness for grapes. The Virginia creeper is another of its food plants. It is very much like the caterpillar of the Satellite Sphinx, except that the white spots on the sides are of another shape.

Five-spotted Hawkmoth (*Protoparce quinquemaculata* Haw. Plate XI, figure 1).—This species is very common, particularly in the South, where, because of its larva's attack upon the tobacco plant, it has long been known as the tobacco fly. Many species of the potato family are to the liking of its larvæ. The green caterpillars with a horn near the tail are easily recognized.

Big Poplar Sphinx (*Pachysphinx modesta* Harr. Plate XI, figure 2).—The Big Poplar Sphinx is one of the noblest of the Hawkmoths. It ranges over the entire United States and its caterpillars feed on poplars, willows, and kindred trees. There are several varieties of this species, the Western one being paler than that which dwells in the East, to match better the lighter colors of the dry western plains.

Hydrangea Sphinx (*Ampelocca versicolor* Harr.—also known as *Darapsa versicolor*. Plate XI, figure 3).—There are few lovelier moths than this beautiful species, which ranges from New England to South Carolina and westward toward the Mississippi River. Its caterpillars feed upon the wild hydrangea, which is found in deep, wooded glens, along the margins of small streams.

Lettered Sphinx (*Deidamia inscripta* Harr. Plate XI, figure 4).—This "learned" member of the Sphinx family is a common species in western Pennsylvania, but is not often encountered in the remainder of its range, which



© National Geographic Society Two-thirds Natural Size

THE NIGHT-FLYING LUNA (4) IS THE PREMIER BEAUTY OF THE MOTH WORLD

(1) Mendocino Silk-moth, *Saturnia mendocino* Behr.; (2) Pamina Moth, *Hyperchiria pamina* Neum. —also known as *Automeris pamina;* (3) Range Caterpillar Moth, *Hemileuca oliviae* Ckll.; (4) Luna Moth, *Actias luna* L.; (5) Buck-moth, *Hemileuca maia* Dru.; (6) Pandora Moth, *Coloradia pandora* Blake; (7) *Pseudohazis eglanterina* Bdv.; (8) Io Moth, *Hyperchiria io* Fabr. [Male]—also known as *Automeris io;* (9) Io Moth, *Hyperchiria io* Fabr. [Female]—also known as *Automeris io.*

extends from Canada to Virginia and westward to the Mississippi. Its caterpillar feeds upon the wild grapevine and woodbine.

Pholus typhon Klug. (Plate XI, figure 5).—This species has a limited distribution, being reported only from Arizona and Mexico. It is a close relative of the Satellite Sphinx (see Color Plate X).

Nessus Sphinx (*Amphion nessus* Cram. Plate XI, figure 6).—Ranging from Canada to Georgia and thence westward to the Rocky Mountains, this Sphinx is a day flyer. The wild grape is one of its favorite food plants.

Erinnyis caicus Cram. (Plate XI, figure 7).—This is a tropical species which occurs occasionally in Florida. It is marked like its close cousin, the Ello Sphinx, which is the commonest of all the Hawkmoths of the American Tropics and has straggled as far north as Canada.

Hog Sphinx (*Ampeloeca myron* Cram.—also known as *Darapsa myron.* Plate XI, figure 8).—The Hog Sphinx is a resident of the Atlantic States, but its range extends as far west as Kansas and Iowa. Its caterpillars feed upon wild and domestic grapevines and the Virginia creeper; but they never become sufficiently numerous to do serious damage, since certain species of ichneumon flies employ them as larders for their own young. The female flies deposit their eggs upon the skin of the young caterpillar. When these hatch the larvæ penetrate the skin of the host, and before the latter has reached maturity are ready to pupate themselves, which they do by weaving little white cocoons on the backs of the caterpillars. Those which escape this parasitization make themselves loose cocoons of closely woven threads of silk, spun under leaves at the surface of the ground, which is the orthodox method of many Hawkmoths.

Alope Sphinx (*Erinnyis alope* Dru. Plate XI, figure 9).—This is another tropical species which occurs in southern Florida and possesses typical Hawkmoth attributes.

Lesser Vine Sphinx (*Pholus fasciatus* Sulz. Plate XI, figure 10).—The Lesser Vine Sphinx is quite common in the Gulf States, though more abundant in tropical Latin America. Stragglers of the species have been taken as far north as Massachusetts.

White Birch Under-wing (*Catocala relicta* Wlk. Plate XII, figure 1).—This is one of the Under-wing moths, which have bright colors on the hind wings that do not appear when the insect is at rest. This species frequents the birch trees, and its folded wings perfectly simulate the markings of the birch bark. Its range includes most of the northern Atlantic States area.

Darling Under-wing (*Catocala cara* Gn. Plate XII, figure 2).—The Darling Under-wing is a native of the Appalachian area. Frequenting the maples as *C. relicta* frequents the birches, its forewings are shaded to give it protective coloration when resting on the maple.

Cirrhobolina mexicana Behr. (Plate XII, figure 3).—This species has a range extending from Colorado and Texas into Arizona and the plateaus of Mexico. It belongs to that same family of moths, the *Noctuidae*, which gives us so many of our army worms and cutworms.

Chalcopasta koebelei Riley (Plate XII, figure 4).—This species is an inhabitant of the arid Southwest, Death Valley being included in its range.

Basilodes pepita Gn. (Plate XII, figure 5).—This is another of the family of *Noctuidae*, whose range extends from Pennsylvania to Florida and westward to Colorado.

Syneda hastingsi Edw. (Plate XII, figure 6).—This member of the family of Noctuids is found in California and Oregon. The moths fly about in the day, alighting on the ground, when the brilliant colors of the hind wings are hidden and they resemble the dust on which they rest.

Stiria rugifrons Grt. (Plate XII, figure 7).—This species has been found in southern Indiana, Kansas, and Colorado. Little is known about the various stages of its existence.

Erebus odora L. (Plate XII, figure 8).—Compared with many of the lesser Noctuids, this magnificent species, the only one of the genus appearing in the United States, is a charming insect. It occurs quite abundantly in the warm areas around the Gulf of Mexico and is sometimes found as a straggler even as far north as Canada. It is widely distributed throughout tropical America. It does not breed in the United States, our examples all being visitants.

Thurberiphaga diffusa Barn. (Plate XII, figure 9).—This is a rare species found in Arizona and New Mexico. The moth flies about the time the wild cotton is in bloom and hides in the flower when resting.

Momophana comstocki Grt. (Plate XII, figure 10).—This is a rare species. All of the specimens that have been taken have been found in New York and Canada, but these have been so few that the species is missing from many museums.

Cirrhophanus triangulifer Grt. (Plate XII, figure 11).—This member of the Noctuid family is found in the Southern States and also as far north as Pennsylvania.

Ultronia Under-wing (*Catocala ultronia* Hbn. Plate XII, figure 12).—This species possesses a number of forms, the one shown being perhaps the commonest. It occurs from Canada to Florida and westward to the Great Plains. The moths alight on tree trunks, which the colors of their upper wings resemble.

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THE AILANTHUS SILK-MOTH (2) IS AN EMIGRANT FROM ASIA

(1) *Hemileuca electra* Wright; (2) Ailanthus Silk-moth, *Samia cynthia* Dru.—also known as *Philosamia cynthia;* (3) *Agapema anona* Ottol.; (4) Tricolor Buck-moth, *Hemileuca tricolor* Pack.; (5) Polyphemus Moth, *Telea polyphemus* Cram.; (6) Nevada Buck-moth, *Hemileuca nevadensis* Stretch; (7) *Rothschildia jorulla* West.; (8) Spice-bush Silk-moth, *Callosamia promethea* Dru.

Variegated Cutworm Moth (*Peridroma margaritosa* Haw. Plate XII, figure 13).—This species is one of about a dozen of the genus found in the United States. It is the moth of the common variegated cutworm, so destructive to grass and low vegetation.

Clouded Locust Under-wing (*Euparthenos nubilis* Hbn. Plate XII, figure 14).—This is a somewhat rare species which occurs from the northern Atlantic States to Arizona. The caterpillars frequent the locust trees and are colored like the bark on which they rest.

Mexican Tiger-moth (*Apantesis proxima* Guer. Plate XIII, figure 1).—The Mexican Tiger-moth occurs in southern California, Arizona, Mexico, and Central America. The genus to which it belongs is essentially an American one, there being only two species attributed to it in the Old World. Its family, the *Arctiidae*, includes more than 2,000 species, being represented in North American life by 38 genera, subdivided into about 120 species.

Leopard-moth (*Ecpantheria deflorata* Fabr. Plate XIII, figure 2).—This species ranges from southern New England into Mexico, being rare in its northern territory and abundant in the southern part of its range. The big black red-banded caterpillar covered with coarse black bristles is very striking but not often found.

Beautiful Utetheisa (*Utetheisa bella* L. Plate XIII, figure 3).—A visitor to the blossoms of the goldenrod, *U. bella* is seen in the late summer and fall in the States of the Atlantic seaboard. The only other member of the genus to which it belongs found within the United States is *U. ornatrix*, which occurs in southern Florida. The larvæ live in open webs, resembling spiders' webs, on wild-indigo and similar plants.

Acraea Moth (*Estigmene acraea* Dru. Plate XIII, figures 4 and 9).—This moth is one of the most frequently occurring in the Middle Atlantic States. There are several varieties and the two sexes wear different clothes. The larvæ are the brown "woolly bears" so often seen in lawn and garden.

Colona Moth (*Haploa colona* Hbn. Plate XIII, figure 5).—The Colona Moth is the largest species of its genus. Although found occasionally in the North Atlantic States and more frequently in the South Atlantic group, it is most abundant in the region of which Texas is the center. It occurs in local colonies, abundant where found, absent elsewhere. The species of its genus are noted for their lack of consistency in color reproduction, it being somewhat difficult to find a group of individuals possessed of uniform markings. Heredity clearly has not yet set their colors.

Big Halisidota (*Halisidota ingens* H. Edw. Plate XIII, figure 6).—This species is found in the Rocky Mountains and in Arizona. It belongs to an extensive genus well represented in Central and South America and containing about a dozen species within the territory of the United States. It belongs to a group of species the larvæ of which feed on spruce and hemlock.

Spotted Halisidota (*Halisidota maculata* Harr. Plate XIII, figure 7).—The Spotted Halisidota has a range that covers the northern part of the United States. The black and yellow tufted caterpillars are often seen on willow and alder in the fall.

St. Lawrence Tiger-moth (*Hyphoraia parthenos* Harr. Plate XIII, figure 8).—The St. Lawrence Tiger-moth belongs to a subarctic genus which is distributed in the subarctic areas of North America, Asia, and Europe. The present species occurs most frequently in the St. Lawrence Valley, northern New England, and westward to Manitoba. Occasionally it is found in the Catskills.

Painted Arachnis (*Arachnis picta* Pack. Plate XIII, figure 10).—This species is found in Colorado, southern California, and northern Mexico. The food plants of its caterpillars are the lupines and their relatives, though they are rather general feeders on low plants. The caterpillars are black covered with dense spiny hairs.

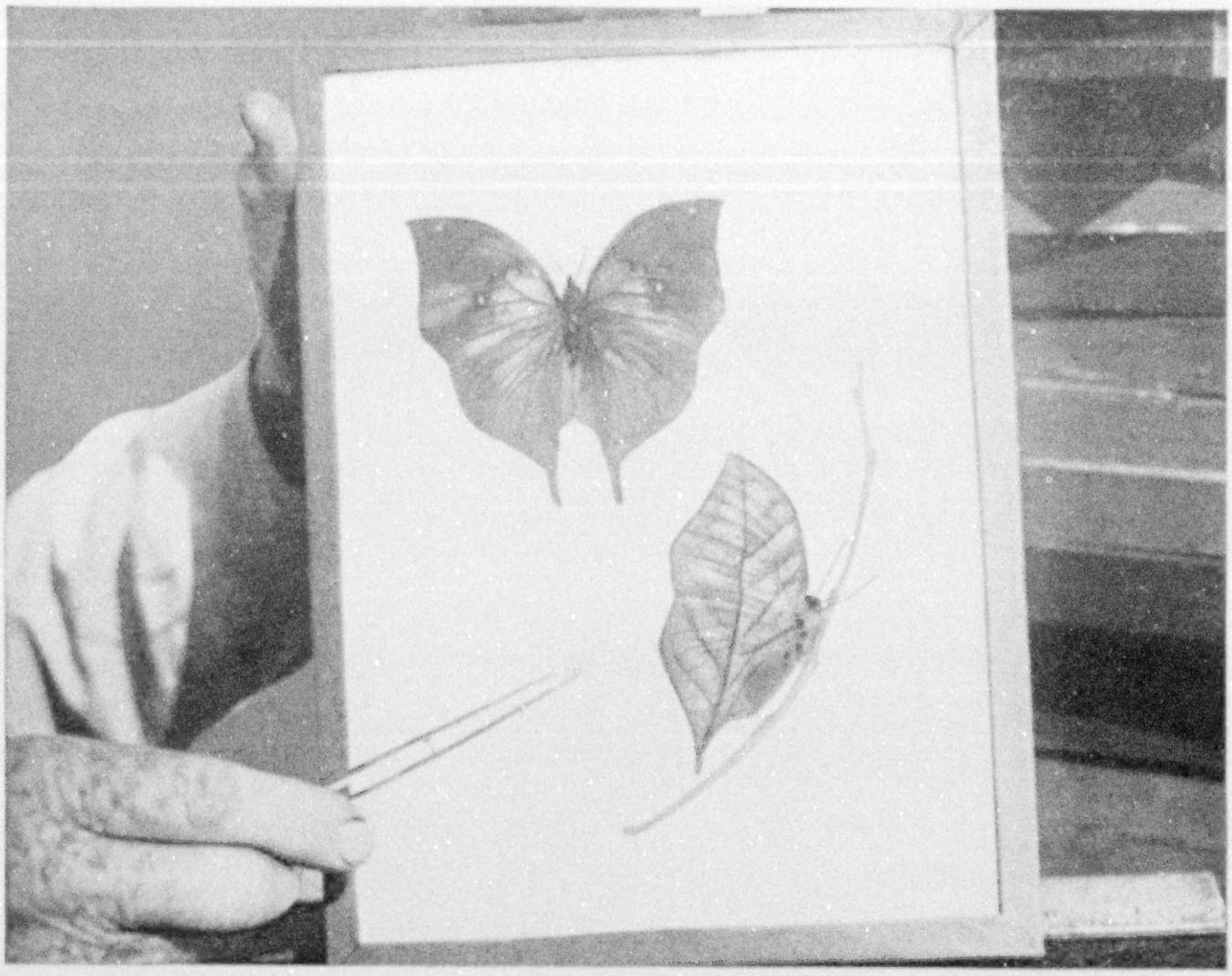
Virgin Tiger-moth (*Apantesis virgo* L. Plate XIII, figure 11).—The Virgin Tiger-moth is a resident of the northern Atlantic States and Canada. The cream-colored stripes on the black wings made the pioneer American entomologist, T. W. Harris, think of a horse's leather harness, and he named one species of the genus *phalerata* "harnessed."

Showy Holomelina (*Eubaphe ostenta* Hy. Edw.—also known as *Holomelina ostenta*. Plate XIII, figure 12).—As its name implies, the Showy Holomelina is a splendidly colored insect. It has been found in Colorado, New Mexico, Arizona, and across the Rio Grande. Little is known of its life history.

Isabella Tiger-moth (*Isia isabella* A. & S. Plate XIII, figure 13).—The Isabella Tiger-moth is the adult of the clipped woolly bear, the fore part of whose body is covered with black hairs, as is also the tail, but the third quarter of which wears a beautiful surcingle of red, all the hairs of the same length. Lutz says that experiments made by him indicated that those which appear after wet spells wear more black than those which follow dry weather, but this surmise is doubtful.

Crimson-bodied Lichen-moth (*Lerina incarnata* Bdv. Plate XIII, figure 14).—This species is a resident of Arizona and Mexico and is so different from all other species that a special genus was set up by classifiers for its accommodation.

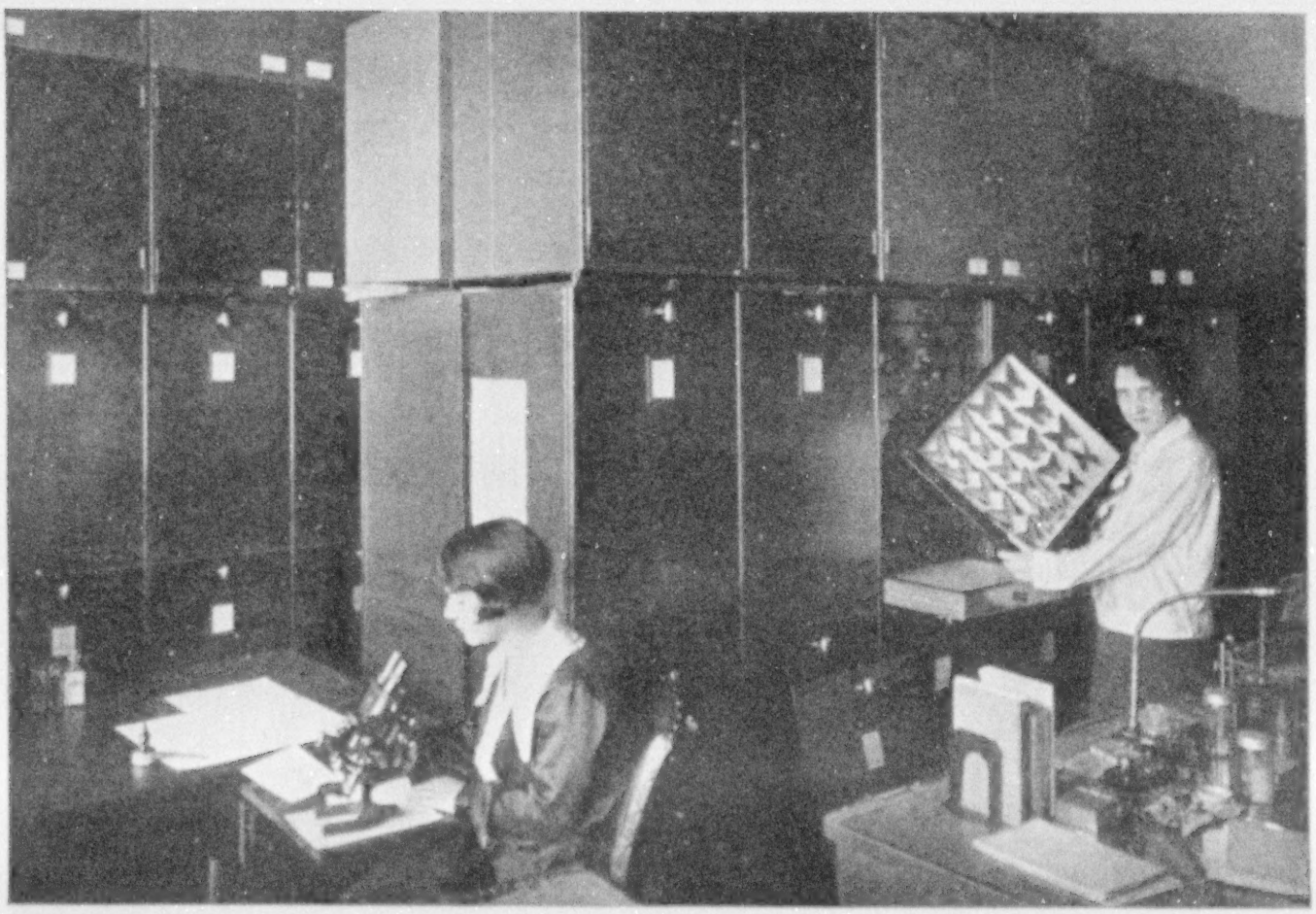
Milk-weed Moth (*Euchaetias egle* Dru. Plate XIII, figure 15).—The Milk-weed Moth claims most of the United States east of the Rocky Mountains as its territory. Its pretty caterpillars are tufted with black, white, and orange, and may be found, many together, on



Photograph from International Newsreel

A KALLIMA BUTTERFLY ON THE WING AND AT REST

Note how this native of India when alight simulates a leaf on a twig (see text, page 88).



Photograph by Charles Martin

WHERE THE NATIONAL MUSEUM PRESERVES ITS MOTHS AND BUTTERFLIES

There are many insect foes of museum specimens which must be constantly guarded against by the use of naphthalene preparations.

the backs of milkweed leaves, their favorite food. Be careful when you turn the leaf or they will all drop off.

Ranchman's Tiger-moth (*Platyprepia virginalis* Bdv. Plate XIII, figure 16).—Occupying what was formerly the cowboy country of the West, this species came by its name of Ranchman's Tiger-moth quite naturally. It is common in Colorado, Wyoming, and Montana, and is found in the latitude of these States to the Pacific coast. The larvæ are found in grass and garden. They look like our "woolly bears," but the hair is softer.

Fall Web-worm Moth (*Hyphantria cunea* Dru. Plate XIII, figure 17).—The range of the Fall Web-worm Moth extends from southern New England to Texas and westward. Its larvæ spin great webs in the foliage of almost all kinds of deciduous trees in the summer and fall, and do much damage to shade trees in nurseries and orchards, the apple and the ash being among its favorites. There is a considerable variation in the markings of both larvæ and adults. The pupa weaves a loose cocoon and hibernates in crevices of brick, porous soil, etc. The eggs are laid in flat masses on the under side of leaves.

Photograph Courtesy U. S. Department of Agriculture

ONE OF THE SPHINX MOTHS, SHOWING HOW THOROUGHLY IT BLENDS WITH ITS SURROUNDINGS

When moths alight they, as a rule, fold their somber-hued forewings over their brighter underwings, and the former frequently so merge into the color and apparent texture of their environment as to escape the sharp eyes of their foes. This is known as "protective coloration" in biology, but armies call it "camouflage" in war.

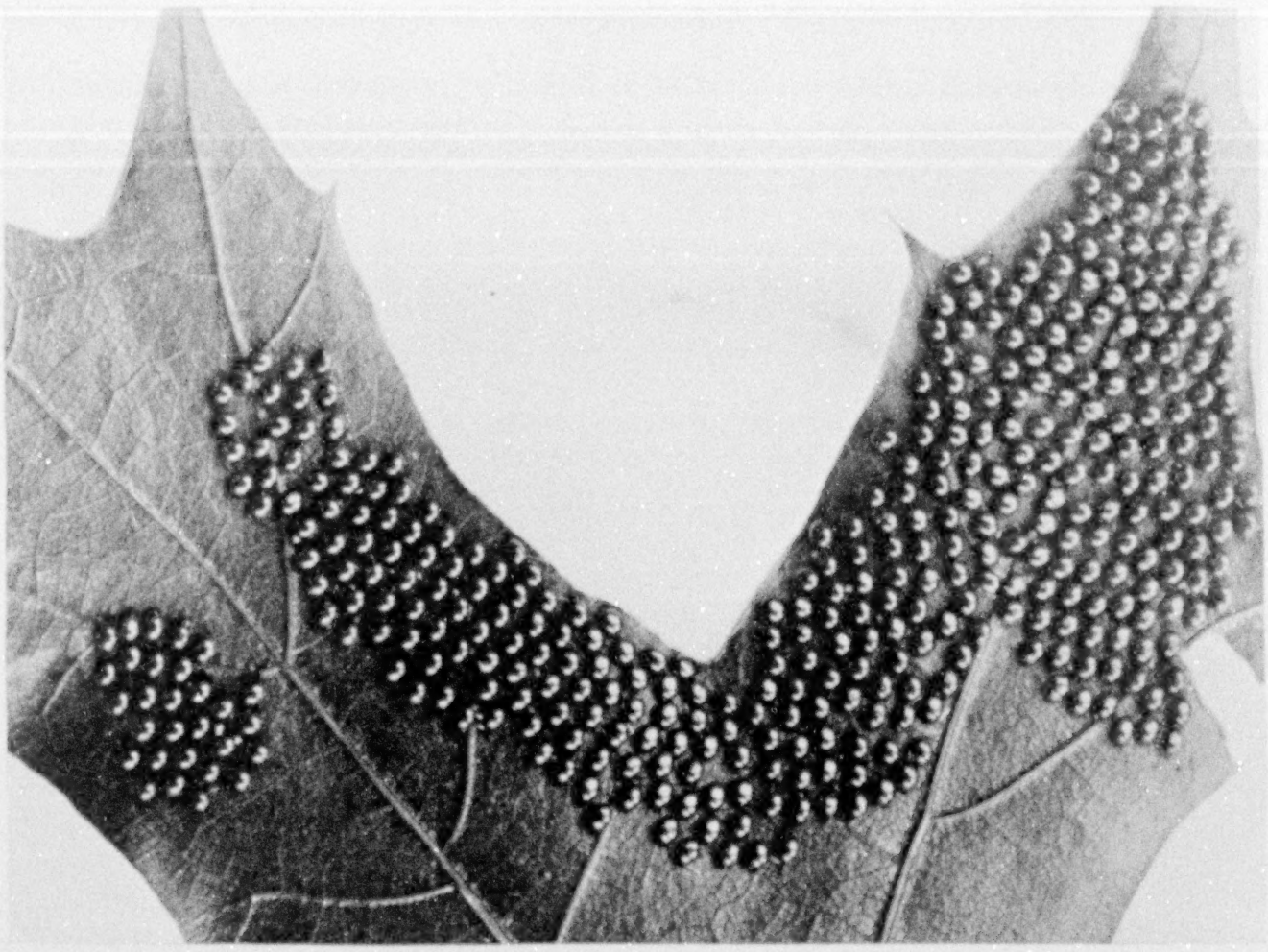
Arctia americana Harr. (Plate XIII, figure 18).—This species occurs in Canada, New England, and northern New York, the caterpillars much resembling those of the Ranchman's Tiger-moth. It is closely allied to its European representative, *Arctia caja* of Linnæus.

Adelocephala isias Bdv. (Plate XIV, figure 1).—This species is found in northern Mexico and southern Texas. The food plant of its caterpillar is the mesquite.

White-lined Syssphinx (*Adelocephala albolineata* G. & R.—also known as *Syssphinx albolineata*. Plate XIV, figure 2).—The White-lined Syssphinx is a native of Mexico and Central America which is occasionally encountered in the region immediately north of the Rio Grande.

Honey-locust Moth (*Adelocephala bicolor* Harr. Plate XIV, figure 3).—The Honey-locust Moth has a range that embraces the area from the Great Lakes southward to Georgia and Kansas. Its caterpillars find the honey-locust and the Kentucky coffeetree especially to their taste. They are green, with silver and red thornlike horns.

Royal Walnut-moth (*Citheronia regalis* Fabr. Plate XIV, figure 4).—The Royal Walnut-moth is one of the most attractive of our larger scaly wings. Its caterpillar, on the



Photograph Courtesy U. S. Department of Agriculture

EGGS OF THE ORANGE-STRIPED OAK-WORM MOTH ON AN OAK LEAF

The species of moth that laid these eggs is shown in figure 6 on Color Plate XIV. Some moths lay only one egg to a leaf or even to an entire bush, while others lay great masses of them. In some cases they lay more than their entire body weight of eggs in a few days.

other hand, wears such an aspect that it has been called the "hickory horn devil" (see illustration, page 84). In the mature caterpillar these horns are reddish, tipped with black. Forbidding as they appear to be, they are quite harmless, as is their owner. These caterpillars feed on the foliage of such trees as walnut, hickory, butternut, ash, persimmon, sweetgum, and sumac. This moth is not uncommon in the Atlantic States.

Rosy Maple-moth (*Anisota rubicunda* Fabr. Plate XIV, figures 5 and 7).—The Rosy Maple-moth ranges from Canada to the Carolinas and westward to Kansas. Its striped caterpillar is a pest of silver maple trees. One scientific observer reports that this moth, once abundant in the Pittsburgh region, is now very scarce there, and attributes its disappearance to a group of adverse conditions, including odors from natural gas wells, flames from many chimneys which attract and destroy millions of adult insects, and the abundance of English sparrows.

Orange-striped Oak-worm Moth (*Anisota senatoria* A. & S. Plate XIV, figure 6).—The Orange-striped Oak-worm Moth is one of five species of its genus found in the United States. It is an Eastern species, closely related alike to the Stigma Moth and the Virginian Anisota. The hard, striped, horny larvæ are so stiff that they can be picked up and held by the tail.

Imperial Moth (*Eacles imperialis* Dru.—also known as *Basilona imperialis*. Plate XIV, figure 8).—The Imperial Moth has a rather wide range, and its caterpillars feed upon such a large variety of trees that they find relished pastures wherever they go. Like the Royal Walnut-moth, it has a wing-spread of five inches. The caterpillars of both of these species burrow into the ground to pupate, spending the winter as rough, brown, naked chrysalids.

Heiligbrodt's Syssphinx (*Adelocephala heiligbrodti* Harv.—also known as *Syssphinx heiligbrodti*. Plate XIV, figure 9).—This species is found in some sections of the Southwest, particularly in Arizona. Its caterpillars feed on greasewood bushes.

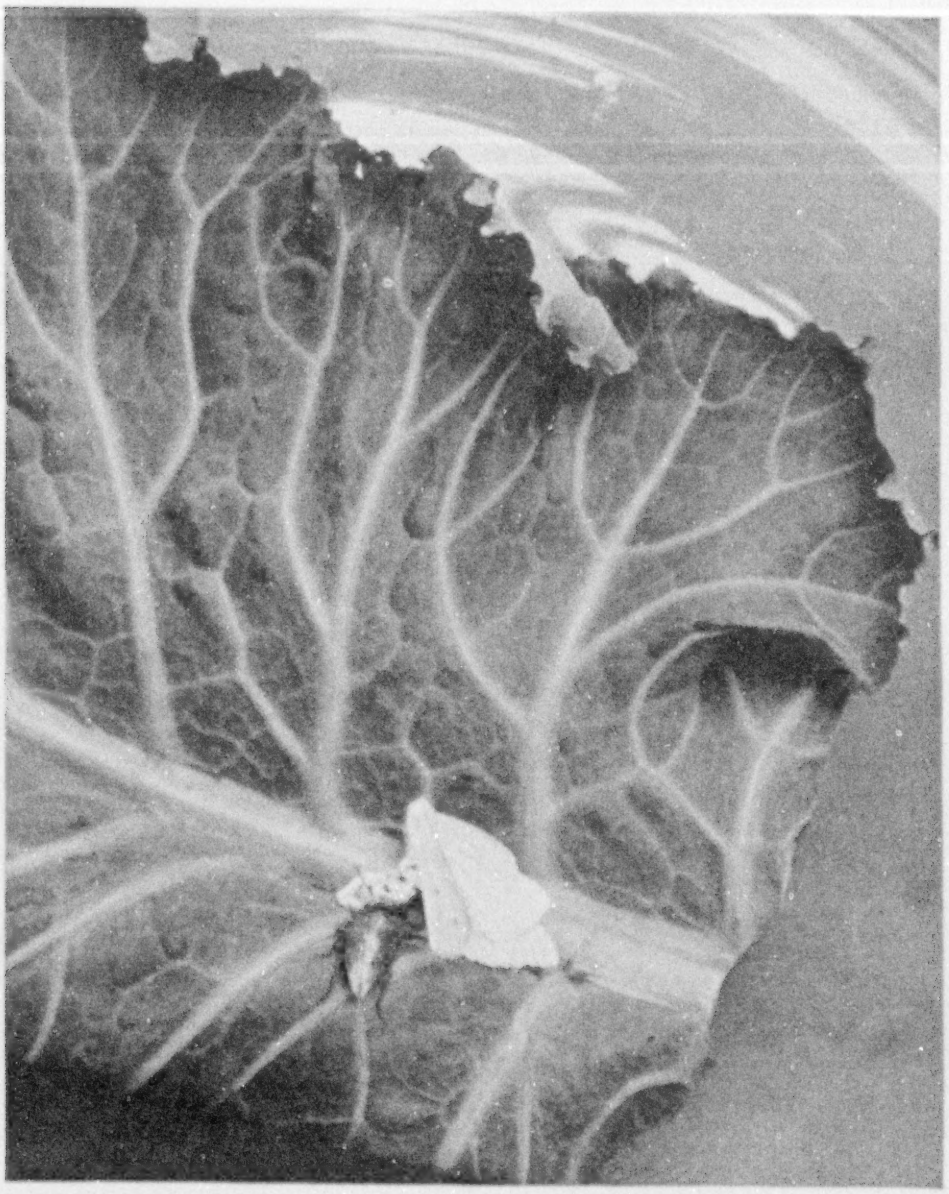
Stigma Moth (*Anisota stigma* Fabr. Plate XIV, figures 10 and 11).—The Stigma Moth's range extends from Canada to the Carolinas and westward to the Rocky Mountains. Its caterpillars feed upon various species of oak, principally the white oaks, whereas *A. senatoria* favors the black and red oaks.

Mendocino Silk-moth (*Saturnia mendocina* Behr. Plate XV, figure 1).—The Mendocino Silk-moth is found mainly in northern California. Its caterpillars feed upon manzanita.

Pamina Moth (*Hyperchiria pamina* Neum.—also known as *Automeris pamina*. Plate XV, figure 2).—This moth is found in Arizona. It is closely related to the more familiar Io Moth (see figures 8 and 9). Its pastures have been devastated by sheep herders and it is now extremely rare, if not extinct.

Range Caterpillar Moth (*Hemileuca oliviae* Ckll. Plate XV, figure 3).—This is another of the many species of tropical moths which is sparsely found along the southern borders of our Southwest. The caterpillars feed on grass and may destroy miles of grazing land, so that cattle starve.

Luna Moth (*Actias luna* L. Plate XV, figure 4).—The Luna Moth is found from Canada to Florida, and thence westward to Texas and Mexico. It is noted for its delicate green tinting and exquisite wing symmetry. The caterpillars feed on hickory, walnut, and other forest trees and pupate in thin, but compact, cocoons made of silk and leaves, on the ground.



Photograph Courtesy U. S. Department of Agriculture

THE MOTH OF ONE OF THE WOOLLY BEAR TRIBE IS ATTACKED BY A SPINED TREE-BUG

In the insect world "every individual's hand is against every other's," and between the parasitic gnats and mites that lay their eggs on the bodies of the caterpillars and the hundreds of insects, birds, and other foes which prey upon the adults, the Lepidopters have a perilous existence at best.

Buck-moth (*Hemileuca maia* Dru. Plate XV, figure 5).—The Buck-moth is a day flyer and wanders abroad in the mellow and warm noondays of the autumn, when the leaves are falling. It frequents the oak and other plants, where it deposits its eggs in clusters. The range of the Buck-moth extends from Nova Scotia to Florida and westward to Kansas. The black, spiny caterpillars feed together in companies until large, following each other in single file down the stems.

Pandora Moth (*Coloradia pandora* Blake. Plate XV, figure 6).—The Pandora Moth is a resident of the mountains of the West from Montana and Washington southward to Mexico. The larvæ are found on pine trees and are considered a great delicacy by the Indians, who make a, to us, disgusting soup of their bodies.

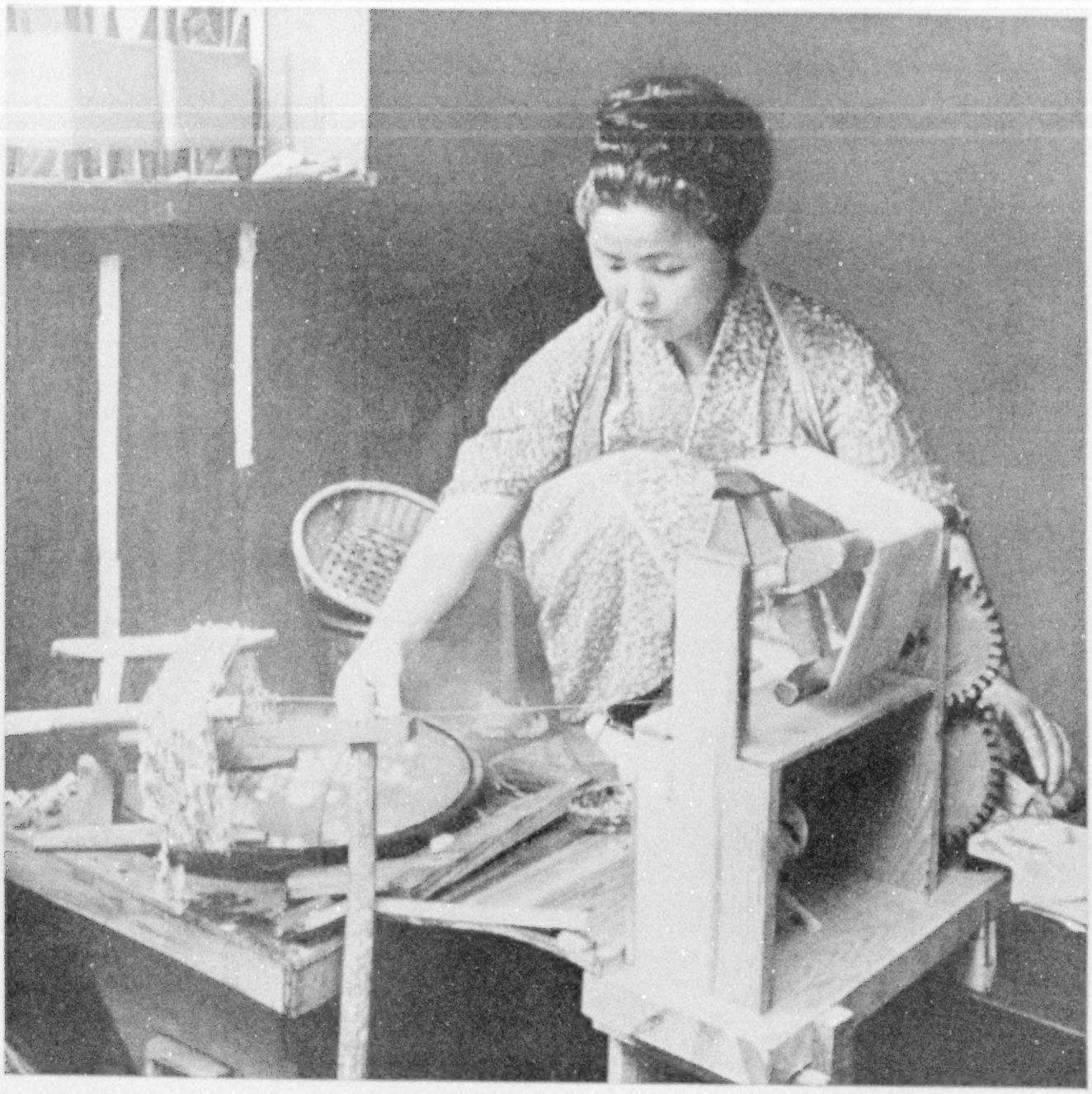
Pseudohazis eglanterina Bdv. (Plate XV, figure 7).—This species occupies the Rocky Mountain area and is characteristic of the country of open timber. It is largely a day flyer, darting about through the woods without apparent object. The adults take no food, the mouth parts being aborted. The larvæ feed on wild rose and other bushes.

Io Moth (*Hyperchiria io* Fabr.—also known as *Automeris io*. Plate XV, figures 8 and 9).—The fair Io Moth ranges from Canada to Florida and westward to Texas and Mexico. It has a versatile taste, so that its caterpillars find "skittles and beer" in a large number of species of trees and shrubs, low plants, and even clover. The caterpillars, with their clusters of branching spines, might be called the "curly poodles" of the insect world. The spines

Photograph Courtesy American Museum of Natural History

A THOUSAND MIGRATORY MONARCH BUTTERFLIES IN ONE GROUP

In early autumn Monarch butterflies, *Anosia plexippus* (see Color Plate IX, figure 12), assemble in great swarms in the northeastern section of the United States. This exhibit is in the halls of the American Museum of Natural History.



Photograph by Keystone

REELING SILK IN JAPAN

While the silk of commerce is made from cocoons whose chrysalids have first been killed by heat, the fine old silks of rarer sheen in China were usually woven from strands reeled from live cocoons (see text, page 97).

are covered with stings, which produce a sensation like nettle when coming in contact with the back of the hand or arm.

Hemileuca electra Wright (Plate XVI, figure 1).—This is a relative of the Buck-moth previously described (see Plate XV, figure 5). It is found in southern California.

Ailanthus Silk-moth (*Samia cynthia* Dru.—also known as *Philosamia cynthia*. Plate XVI, figure 2).—The Ailanthus Silk-moth is an immigrant to America. It was imported from eastern Asia and became thoroughly adapted to the eastern seaboard region of the United States. Its importation was for the purpose of founding a silk industry in the United States; but, although it is possible to make a good grade of coarse silk from it by process of carding, no profitable method of reeling the cocoons has been found, and therefore its importation has served no useful purpose. It feeds on the imported ailanthus tree and is a delight to every embryo naturalist.

Agapema anona Ottol. (Plate XVI, figure 3).—This species is found in Mexico and rarely in Arizona. It is a pretty species, but little is known of its habits.

Tricolor Buck-moth (*Hemileuca tricolor* Pack. Plate XVI, figure 4).—Arizona and New Mexico constitute the range of the Tricolor Buck-moth in the United States. Like most of their relatives, its caterpillars feed on the foliage of greasewood.

Polyphemus Moth (*Telea polyphemus* Cram. Plate XVI, figure 5).—This species is widely distributed over the United States and feeds upon a large number of trees. Fruitless efforts

Photograph Courtesy U. S. Department of Agriculture

WOOD-TRIMMED COCOONS OF THE PSYCHE MOTH, COMMONLY CALLED THE BAGWORM

The caterpillar of this moth makes a shell of silk and twigs to protect its tender body, only the head and forelegs remaining exposed. When the time to pupate arrives, the larva merely attaches its house (now a cocoon) securely to a branch, and backs into it and sheds to become a pupa (see text, page 93).

have been made to reel the silk it spins. The green worms are plaited like an accordion and studded with little red buttons.

Nevada Buck-moth (*Hemileuca nevadensis* Stretch. Plate XVI, figure 6).—This species resembles *H. maia* so much that some authorities class it as only a variety of the latter. Its range extends from the Rocky Mountains to the Pacific.

Rothschildia jorulla West. (Plate XVI, figure 7).—This moth occurs in Arizona, but is more common in Mexico. The genus to which it belongs is distinctly a neotropical one. These large moths with clear windows in their wings are very striking, being American representatives of the famed Atlas Moth of the East.

Spice-bush Silk-moth (*Callosamia promethea* Dru. Plate XVI, figure 8).—The Spicebush Silk-moth is found in the entire eastern part of the United States. The spicebush and sassafras are its favorite food plants. In pupating the larvæ usually rolls a leaf, tying it with silk, and then spins his cocoon therein, fastening the cocoon to the twig by a band of silk along the leaf stem. Though the fiber of the silk this species makes is rather tough, it is not spun with sufficient system by the present methods to make it available for use, either through carding or reeling.

Notice of change of address of your NATIONAL GEOGRAPHIC MAGAZINE *should be received in the office of the National Geographic Society by the first of the month to affect the following month's issue. For instance, if you desire the address changed for your September number, the Society should be notified of your new address not later than August first.*

For the one hot dish of the summer meal

IN THE summer time, cold meats, salads, iced foods and beverages appear with regularity. So even more than ever it becomes important that your appetite and your digestion should have the benefit of a hot dish with the meal.

Indeed, a savory, hot, invigorating plate of soup is all the more appetizing and attractive at this time.

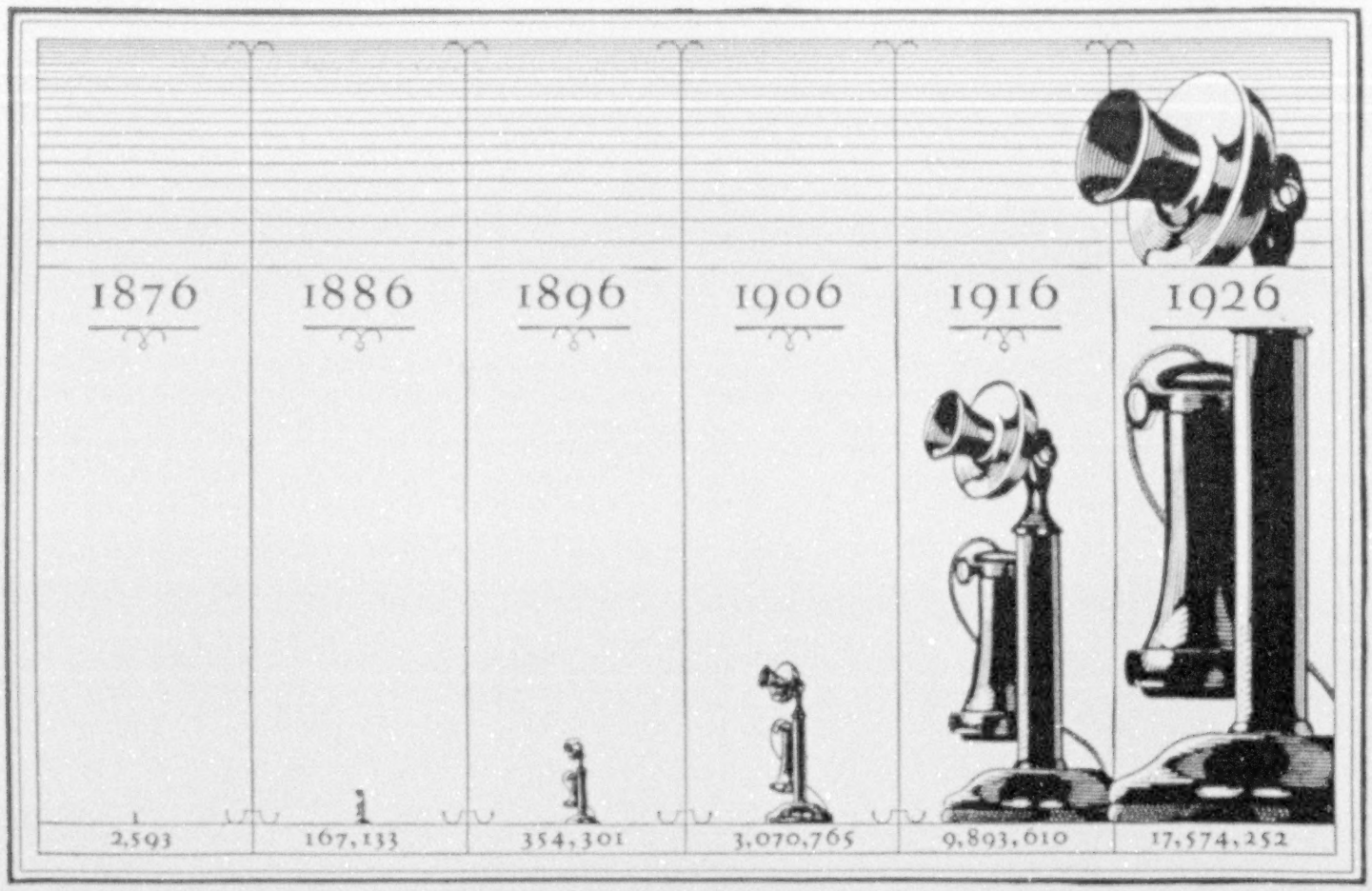
And Campbell's make the serving of soup so easy and convenient! It is merely an incidental in the preparation of the meal. You have only to add the water and let the soup simmer a few minutes before serving—a feature doubly welcome in warm weather.

See that your pantry is liberally supplied with Campbell's Soups. And one of your chief standbys will be Campbell's Vegetable Soup.

With its thirty-two different ingredients, it is substantial enough for many a luncheon or supper, with little else.

Campbells' Soups

LOOK FOR THE RED-AND-WHITE LABEL



Milestones in National Service

An Advertisement of
the American Telephone and Telegraph Company

THERE are twenty-five Bell companies but only one Bell System —and one Bell aim and ideal, stated by President Walter S. Gifford as:

"A telephone service for this nation, so far as humanly possible free from imperfections, errors or delays, and enabling anyone anywhere at any time to pick up a telephone and talk to anyone else anywhere else in this country, clearly, quickly and at a reasonable cost."

The past year brought the service of the Bell Telephone System measurably nearer that goal. Seven hundred and eighty-one thousand telephones were added to the System—bringing the total number interconnected in and with the Bell to more than seventeen and a half million. The number of applications waiting for service, including those in new and outlying sections, was reduced fifty per cent.

A third transcontinental telephone line was completed to the Pacific coast.

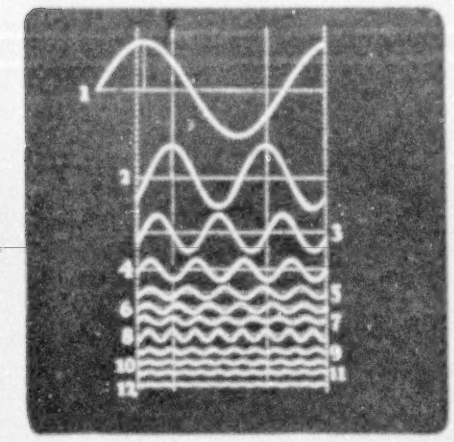
The largest number of miles of toll wire for one year was added to the System—more than 664,000 miles.

The average length of time for completing toll calls throughout the System was lowered by thirty-five seconds.

A seven per cent improvement over the previous year was made in the quality of voice transmission in toll calls.

An adjustment was made in long distance rates amounting to a reduction of about $3,000,000 annually.

And now Thomas A. Edison *answers* another questionnaire



In the photographic diagram above, wave No. 1 is that of the fundamental tone of an organ-pipe. The numerous waves beneath it are that organ-pipe's overtones. They are as elusive as a ray of sunlight, yet their capture and preservation on a phonograph record is utterly essential to full, perfect Re-Creation of an artist's performance. It is obvious that they cannot be preserved if their microscopic strength is dissipated in any way—moving machinery, for example. But let ***Thomas A. Edison*** *give you his views on the subject.*

"I don't use delicate overtones to move machinery."

QUES. What is musical sound?

Ans. When anything such as a tightly stretched string connected to a sounding board is caused to vibrate rapidly and regularly back and forth, it sets the air around it in rapid vibration which in turn vibrates our ear drums back and forth. Through the mechanism of the ear these vibrations are transmitted to our brains and we "hear" a musical sound. Physicists call such vibrations sound waves.

Ques. Sometimes music is rich, mellow and beautiful. Sometimes it is harsh, sharp and unpleasant. Why is this?

Ans. The presence or absence of overtones controls the beauty and quality of a musical sound. The more overtones there are, the richer and more beautiful the quality becomes. The difference between the metallic tinkle of a child's piano and the mellow resonance of a concert grand is due to overtones.

Ques. What are overtones?

Ans. When we set the string I mentioned vibrating, it sends out a powerful or fundamental wave. It also sends out many other related waves. These secondary waves are called overtones.

A simple illustration of this: Drop a large pebble into a pool of quiet water; wave rings are formed that go out in all directions in smooth and regular procession over the surface of the water. Now try dropping the large pebble again, but at the same time drop several very small ones along with it. The wave rings caused by the large pebble will be there as before but, in addition, there will be many little waves or ripples criss-crossing each other, and the appearance of the principal waves will be quite different from what they were in the first experiment.

The big waves may be compared to the fundamental sound wave, and the little ripples that are superimposed on them to the overtones.

Another illustration might be an automobile crossing a series of mountain ridges. The mountains and valleys correspond to the principal or fundamental sound waves and the "thank-you-ma'ams" to the overtones—only in the case of music the "thank-you-ma'ams" are enjoyable.

Ques. What, in effect, do overtones accomplish?

Ans. I've already answered this in Question No. 2. To put it in another way, however, one artist with a few simple lines paints a picture; another paints the same picture but fills out his canvas with backgrounds of light and shade and with subtle color effects. It might be said that the second artist has added overtones to the sharp fundamentals of the first artist's work. The greater the skill in handling the overtones, the greater the master and the more permanently pleasing the effect. This is also true in music.

Ques. Can overtones be recorded on phonograph records?

Ans. Years ago I recognized the fact that only through capturing the delicate and elusive overtones as *well* as the fundamental wave, and faithfully recording them on a record, could phonograph music earn its right to a permanent place in the musical esteem of mankind. I have worked always with this goal in view. Nature has been reluctant, but one by one she has given up her secrets. The present Edison Phonograph is very close to my ideal.

Ques. How have you captured these delicate overtones?

Ans. In many ways. For example, I made a thicker record of greater solidity which would not shake and vibrate as a whole when played. I developed an extremely hard and smooth surface for the record so that the sound waves—the minute ones which are overtones—would not be flattened out when the diamond point passed over them. By adopting a permanent diamond point I got away from making the sound grooves "grind in" steel needles. By mechanically feeding the so-called tone arm across the record I eliminated having the delicate sound grooves *drag* the arm across. In other words, I don't use delicate overtones to move machinery. Countless experiments in recording have taught *us* many vastly important tricks and processes. No one thing has captured the overtones for us. I have mentioned a few but there are many others. A combination of many details working together has achieved present results. ★

Nothing can be better than the BEST

A phonograph serves one purpose and one only—to reproduce voice or instrument *as it sounded originally*. When a phonograph has accomplished this, nothing more can be asked.

Five thousand tests, in which living artists sang or played side by side with the New Edison before critical audiences in such musical centers as Carnegie Hall in New York and Symphony Hall in Boston, have proved that there is no difference between the original performance and the New Edison's Re-Creation of it.

Eminent musical critics who attended these tests were unable to distinguish between the living voices or instrumental performances and the New Edison's rendition of them, and have put themselves on record to that effect. (Send for free booklet, "What the Critics Say.")

The nearest Edison dealer will be glad to demonstrate the New Edison Phonograph to you. Ask him also to play an Edison 40-minute record—the inventor's latest achievement—a record of ordinary size which allows you to hear a complete concert without interruption, and at a marked reduction from the usual cost of phonograph music.

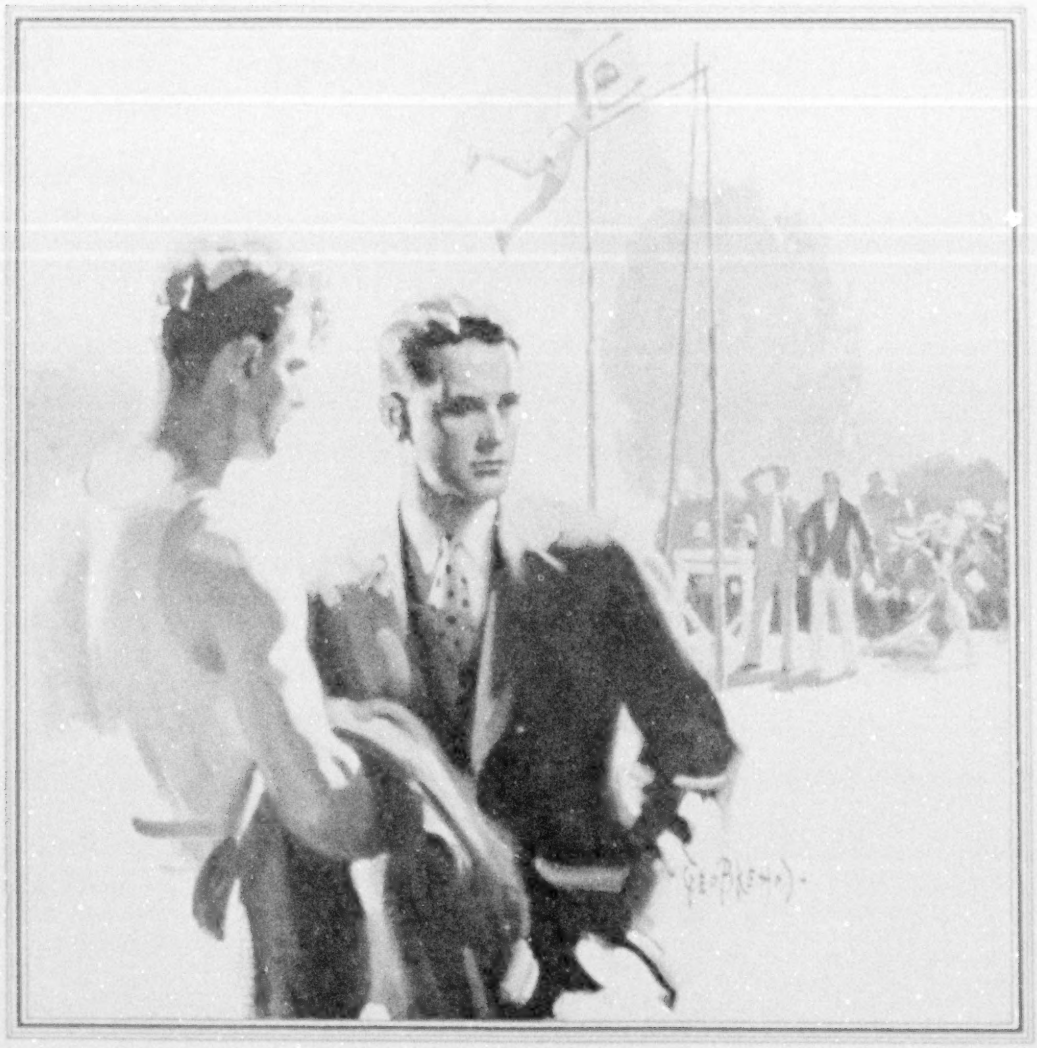
Try the New Edison for a few days in your home, and you will realize what this means. Any Edison dealer will be glad to allow you to make this trial, particularly if you can obtain some other make of machine with which you can compare the New Edison.

THOMAS A. EDISON, Inc.
Orange, N. J.

The NEW
EDISON
PHONOGRAPH

OK Thos A Edison

★ WATCH FOR OTHER QUESTIONNAIRES BY MR. EDISON



Keep your face fit with *Williams*

"Just look at the fine skins of the men who shave with Williams!"

Many a man has said that. And with truth.

The Williams lather makes an *easy* job of shaving because it softens thoroughly. It makes a *smooth* job because it lubricates beautifully.

Best of all, when you're done your face is FIT! The rich, mild, absolutely pure Williams lather tones up the pores, invigorates the whole face tissue, leaves a healthy bloom. Not only for ease in shaving but also for face health and face fitness, there is nothing like a daily treatment of Williams lather.

87 years of intensive, specialized study of lather, beard and skin have gone into every tube of it.

Perhaps that's in the drug clerk's mind when he says, *"Oh, yes . . . but they all come back to Williams!"*

Williams Shaving Cream

Afterwards a dash of Aqua Velva. A FREE sample of this, too, if you say so. Ask Dept. 57.

TWO SIZES — 35c and 50c or—try it first at the cost of a stamp, or post card. A five to ten-day tube of it, with a tidy little hinged cap on the tube, will be sent you FREE.

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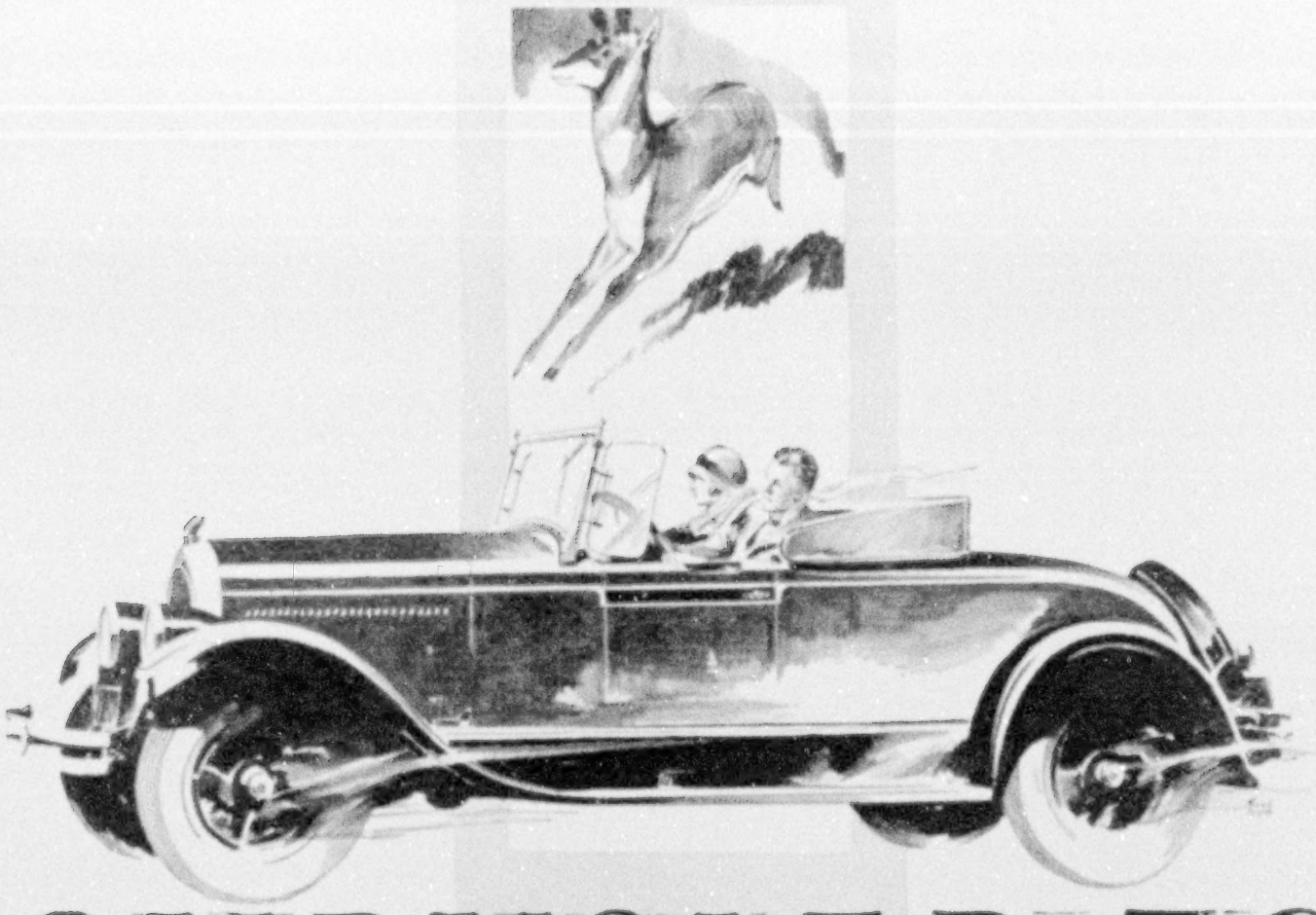
FLEETNESS



CHRYSLER 70

Drive a Chrysler "70" to know and appreciate how much better it is

WE CAN recite to you the advantages of Chrysler "70's" speed of 70 miles plus, its astonishing pickup of 5 to 25 miles in 7¼ seconds.

We can tell you what its scientifically balanced 7-bearing crankshaft and impulse neutralizer contribute toward its greater smoothness; how much more comfortably you ride because of its low chassis design; how much more its unique spring suspension and its shock absorbers contribute to road steadiness; how much more easily it handles because of its pivotal steering gear; and how much safer you feel because of its four-wheel hydraulic brakes.

But the *real* way for you actually to discover these things for yourself is to learn them in an extended test over all sorts of roads, through all sorts of traffic, with *you* doing the driving.

Any Chrysler dealer will gladly accord you the opportunity for such a demonstration.

CHRYSLER MODEL NUMBERS

Sport Phaeton $1495; Two-passenger Roadster, (with rumble seat) $1495; Brougham $1525; Two-passenger Coupe (with rumble seat) $1545; Royal Sedan $1595; Two-passenger Convertible Cabriolet (with rumble seat) $1745; Crown Sedan $1795, f. o. b. Detroit, subject to current Federal excise tax.

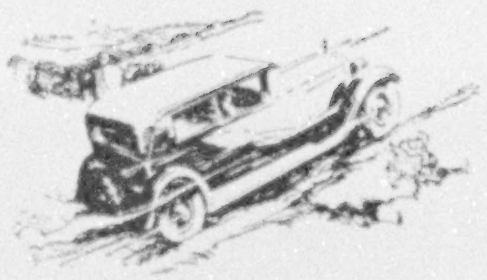
MEAN MILES PER HOUR

Chrysler dealers are in a position to extend the convenience of time payments. Ask about Chrysler's attractive plan. ▸ All Chrysler cars have the additional protection against theft of the Fedco System of numbering.

ETHYL GASOLINE

knocks out that "knock"..

..turns *carbon* into *power*



What Ethyl Gasoline will do in your own automobile

1. It will end all carbon trouble and make carbon formation an asset.

   As carbon forms, both temperature and compression (pressure) are increased. Ethyl Gasoline neutralizes the higher temperature and the increased compression becomes increased power.
2. It will give you more power, particularly on hills and heavy roads.
3. It will make your engine operate more smoothly.
4. It will reduce gearshifting.
5. It will increase acceleration, making your car easier to handle in traffic.
6. It will eliminate "knocking" under all driving conditions.
7. It will reduce vibration and engine wear and tear.
8. It will save the expense of carbon removal.
9. It will give you more power from each gallon of fuel that you use.

IN SHORT, the advantages of Ethyl Gasoline over regular gasoline are so marked as to make the small premium it costs a real economy.

IT is important that you differentiate between Ethyl Gasoline and other "anti-knock" gasolines. Ethyl Gasoline is the *only* fuel which eliminates "knocking" under *all* conditions, thereby making present day automobiles perform more efficiently.

It was developed by General Motors Research Laboratories after 8 years of scientific research which resulted in these two important discoveries.

1. That "knocking" is an inherent characteristic of *all* gasolines. What had previously been called a "carbon knock" or "ignition knock" or "engine knock" is in reality a *fuel knock*, due to the too rapid combustion of gasoline in the cylinders.
2. That "knocking" could be completely eliminated in gasoline by the addition of *Ethyl Brand of Anti-Knock Compound*. This ingredient was discovered by General Motors research engineers after experimenting with more than 33,000 chemical compounds.

SO SUPERIOR is Ethyl Gasoline to other so-called "anti-knock" fuels that it has been adopted wherever unusual performance by a gasoline engine is required. That is why the United States Navy uses Ethyl Gasoline in its latest types of airplanes. That is why Ethyl Gasoline is used by the racing car drivers who are setting up new records.

Ethyl Gasoline is available throughout the United States and Canada through leading oil companies and responsible jobbers. It is sold at pumps which display the "ETHYL" trade mark shown at the left.

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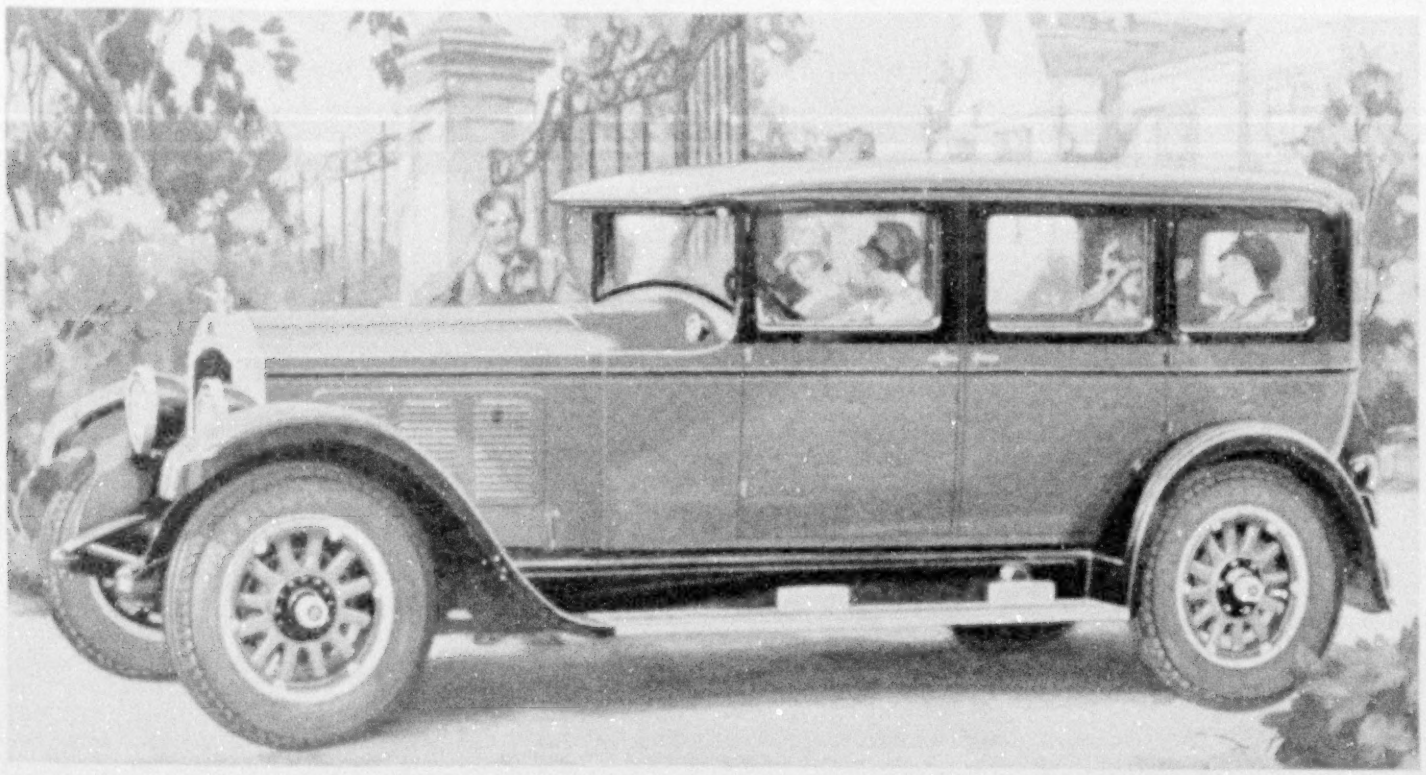
ETHYL GASOLINE
CORPORATION
NEW YORK, U.S.A.
Knocks out that knock



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The Knight Engine—Patented, exclusive. No valve-grinding, no carbon troubles. Constantly grows smoother, quieter, more efficient. Results in *carefree motoring*.

7-Bearing Crankshaft—Of course!

Skinner Rectifier—Keeps your oil healthy and on the job, prevents dilution.

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Belflex Shackles—Keep the chassis as quiet as the Knight Engine. No greasing or adjustment.

Narrow Body Pillars at Windshield—If all cars were so designed accidents would be minimized.

Eight Timken Bearings in Front Axle—Twice as many as in most fine cars. You steer the Willys-Knight without conscious effort.

Adjustable Front Seat—Like a well-tailored suit, designed to fit *you*.

Light Control at Steering Wheel—Lights dimmed without removing your hand from steering wheel.

Shock Absorbers—Air Cleaner. Thermostatic Temperature Control. Finest quality upholstery.

"70" Willys-Knight Six, $1295 to $1495. Willys-Knight Great Six, $1750 to $2950. Prices f. o. b. factory and specifications subject to change without notice. Willys-Overland, Inc., Toledo, Ohio. Willys-Overland Sales Co., Ltd., Toronto, Canada.

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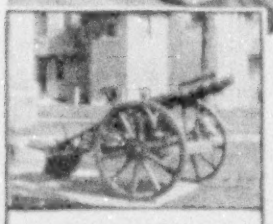

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Can be projected on screen (home or office)

One cent per exposure—one cent per print

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50 pictures on a 50-cent film

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$20 including suede leather carrying case.

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Please send your free 48-page booklet describing Ansco Memo Camera.

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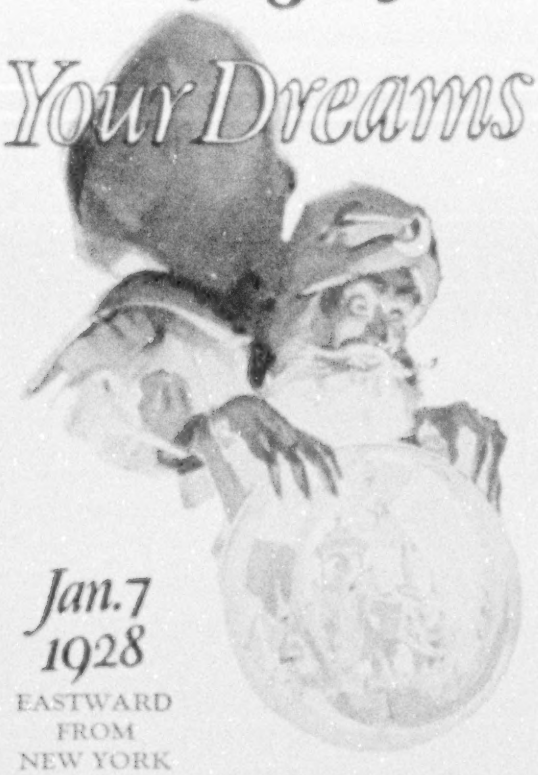

Jan. 7 1928
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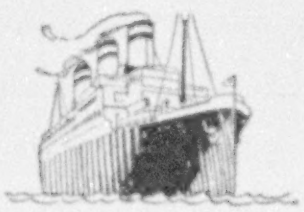
Cruise on the luxurious Resolute, to the wonderlands of the world. The colorful Mediterranean, the Holy Land and Egypt, little-known East Africa, mysterious India, fantastic China and Japan in cherry-blossom time.

In 140 days, you cover 37,849 miles on land and sea—visiting 63 fascinating cities in 30 chosen countries each at the ideal season. All the Oriental Ports of all other world cruises plus Borneo and French Somaliland (East Africa). One experienced management on ship and shore.



The Resolute—built for tropical service—is the ideal cruising steamer with magnificent public rooms; large, airy cabins; sunlit tiled swimming pool and spacious decks.

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Resinol Soap- the choice of the younger set.

Its soothing Resinol properties protect the softness and youth of the skin.

"My skin is very smooth and it is due to the regular use of your wonderful soap."

"I have a skin that is easily irritated, but Resinol Soap soothes it."

". . . delighted to see how soft and smooth it made my skin."

"Resinol Soap is wonderful if one has to use hard water. Does not draw the skin as some soaps do."

"I have so many compliments on my complexion and owe them all to Resinol Soap—the most wonderful soap on the market."

THE above extracts from a few of the letters written to us by enthusiastic girls show that even the youngest of the "younger set" has found that her skin must be watched carefully or it will grow tired looking in this modern age of cosmetics, jazz, and excitement. She has accepted the fact that thorough cleansing once a day is a positive necessity, and she turns to a cleansing agent that will soothe the skin at the same time.

In Resinol Soap the required elements are found because of the special Resinol ingredients which in countless homes represent skin health and beauty. Don't let your skin become sluggish and gray looking because of clogged, smothered pores. Rouse it to activity and help it to throw off the impurities through the vigorous, yet refreshing, soothing action of Resinol Soap.

Begin today to use this delightful toilet soap and you will be giving your skin the protection of daily Resinol treatments. All druggists sell Resinol Soap by the cake or three-cake box, or, if you prefer to try before you buy, send the coupon below for a dainty trial-size cake, free.

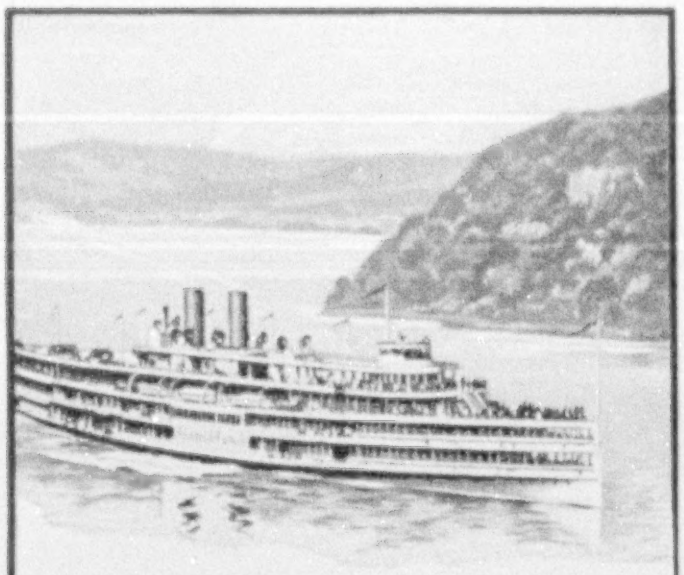
DEPT. 10-F, RESINOL, BALTIMORE, MD.

I have never used Resinol Soap, so please send me a free trial size cake.

Name .....

Street .....

City ..... State .....



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IDEAL SUMMER ROUTE

EASY change from train to boat or boat to train at Albany, making it possible to include this matchless trip in practically any summer itinerary. Ideal one-day outings from New York. Orchestra and restaurant on each steamer.

Service daily including Sunday until Oct. 16th.

Write for time table.

WORLD-FAMOUS STEAMERS

"Hendrick Hudson"
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✓ The END of a *perfect* day

A good car, good roads, and
—a *good hotel.*

After miles and miles of driving, the weary motorist craves appetizing food and sound sleep in attractive surroundings. Make your summer tour a succession of perfect days by including any of the following stop-overs in your itinerary. Each of these fine hotels specializes in hospitable service to the motorist at moderate rates.

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☐ The BENJAMIN FRANKLIN	Philadelphia
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☐ The BANCROFT	Worcester, Mass.
☐ The ROBERT TREAT	Newark, N. J.
☐ The ALEXANDER HAMILTON	Paterson, N. J.
☐ The STACY-TRENT	Trenton, N. J.
☐ The PENN-HARRIS	Harrisburg, Pa.
☐ The TEN EYCK	Albany, N. Y.
☐ The UTICA	Utica, N. Y.
☐ The ONONDAGA	Syracuse, N. Y.
☐ The ROCHESTER	Rochester, N. Y.
☐ The SENECA	" "
☐ The NIAGARA	Niagara Falls, N. Y.
☐ The LAWRENCE	Erie, Pa.
☐ The PORTAGE	Akron, Ohio
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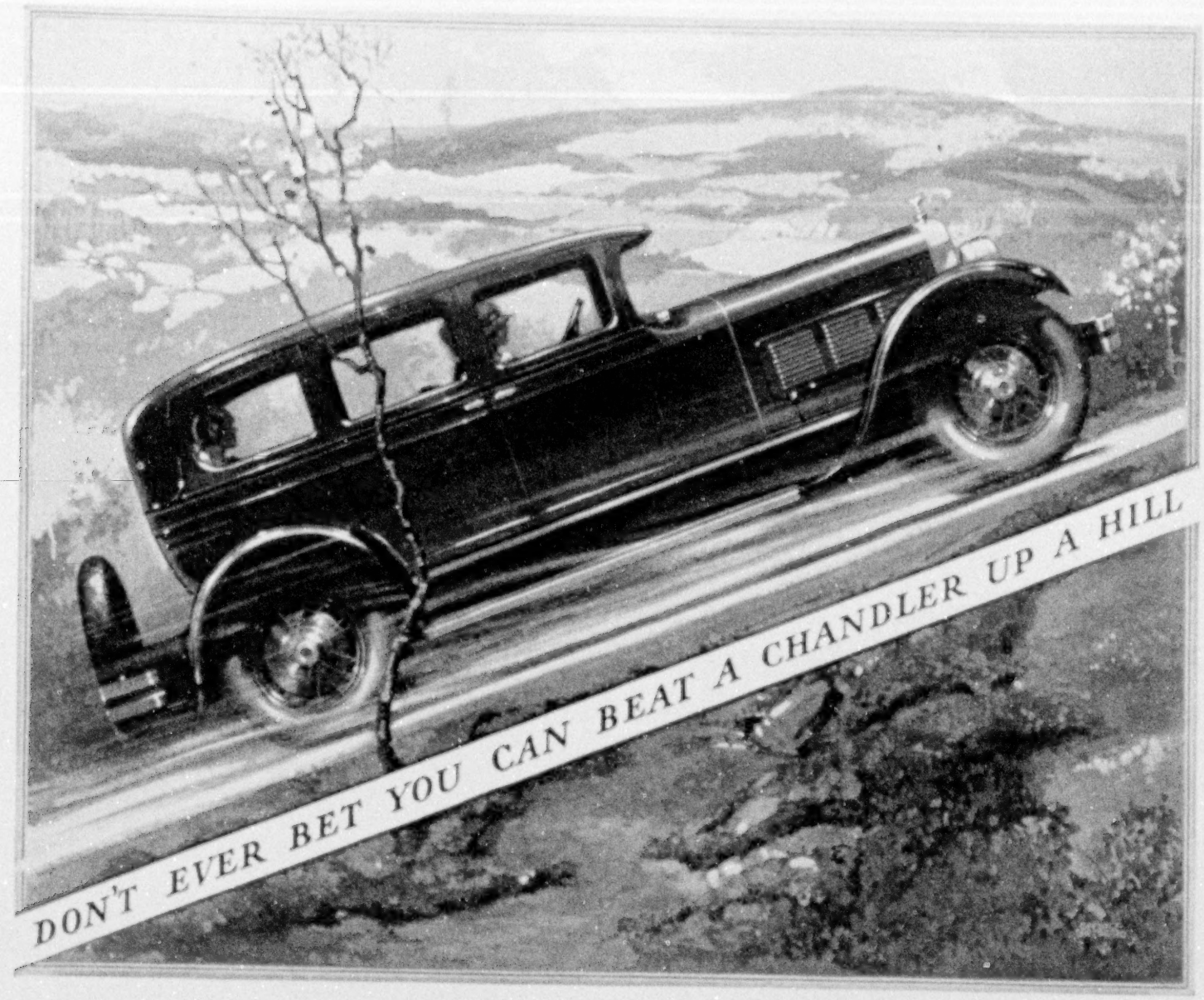

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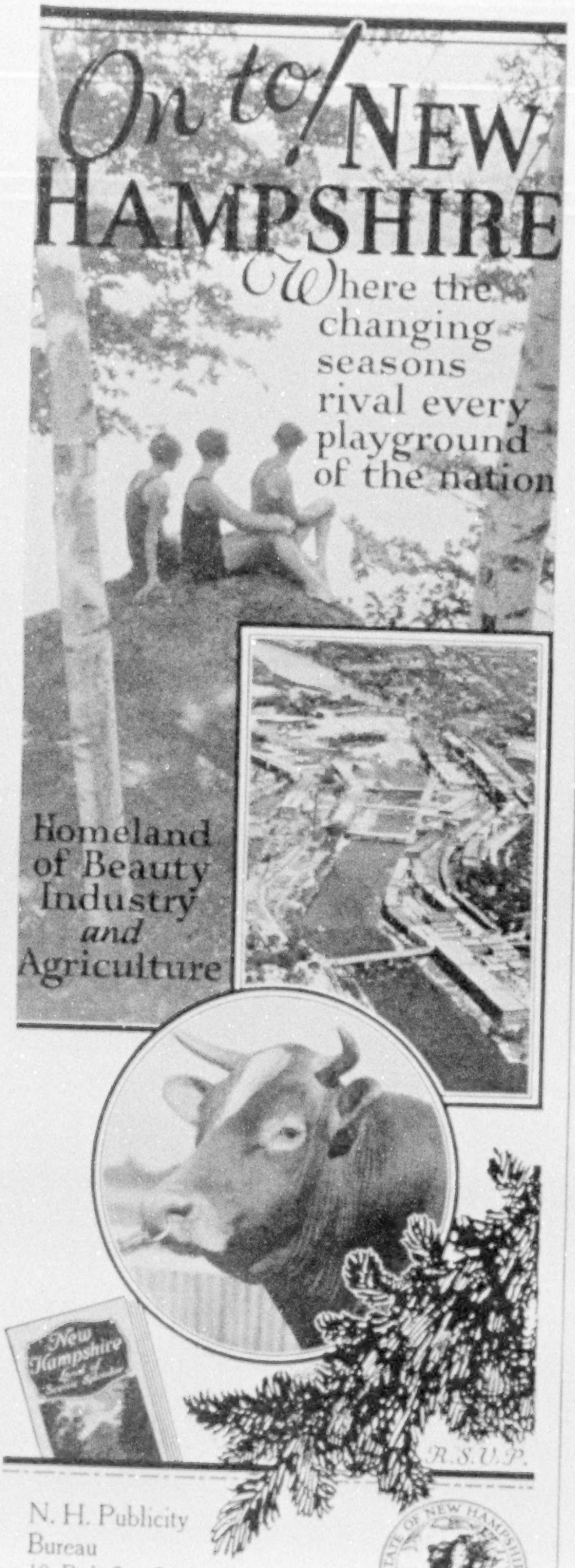
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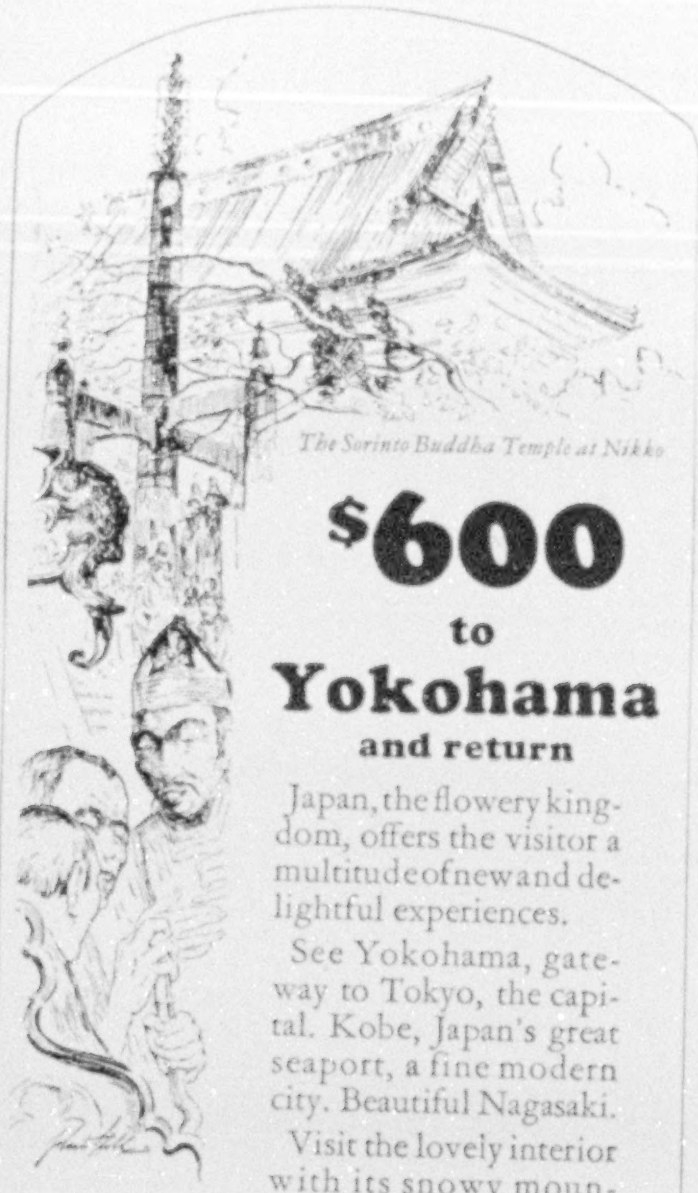

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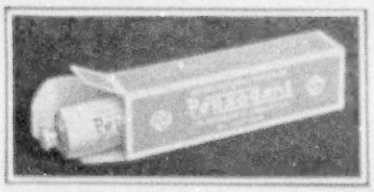

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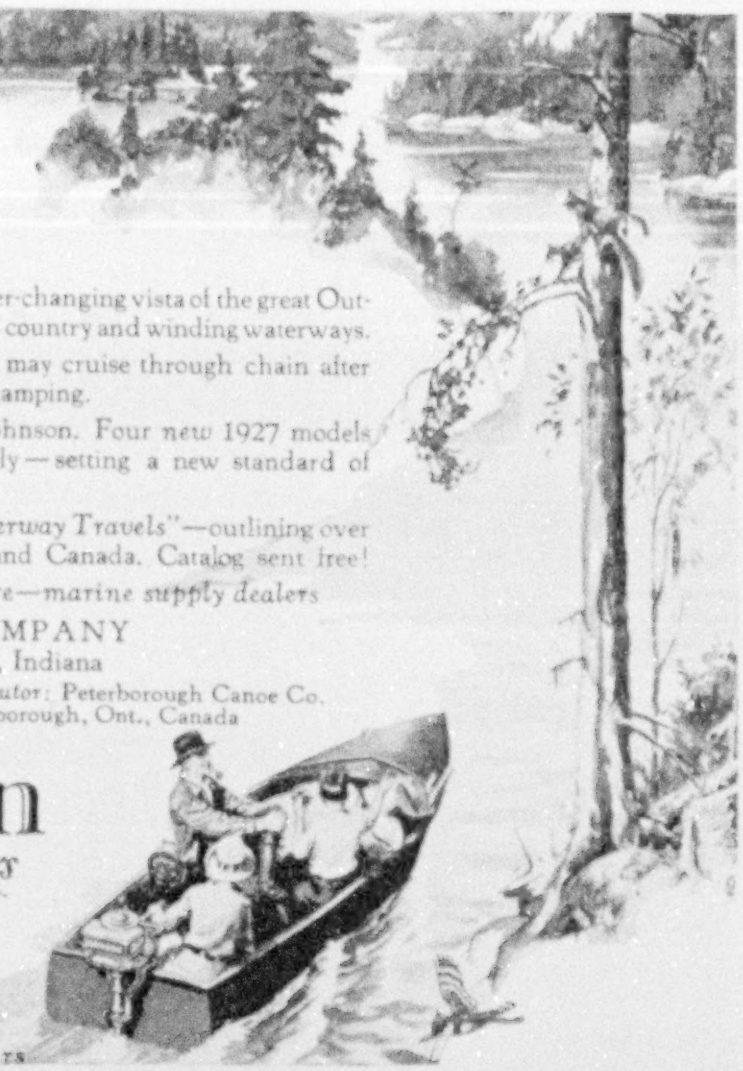

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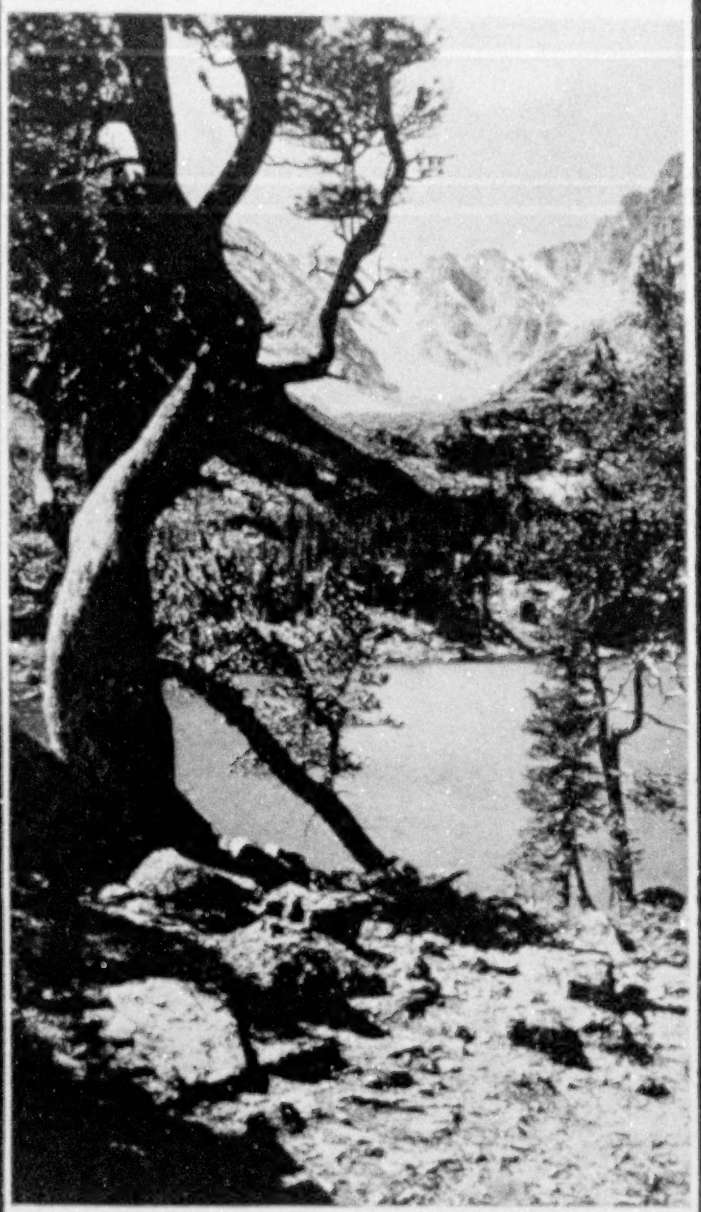

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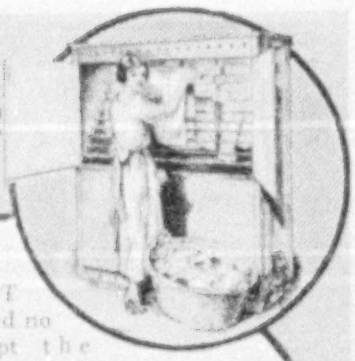

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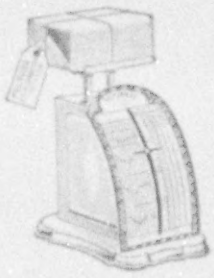

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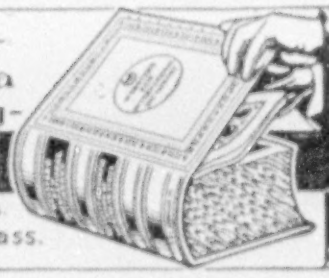

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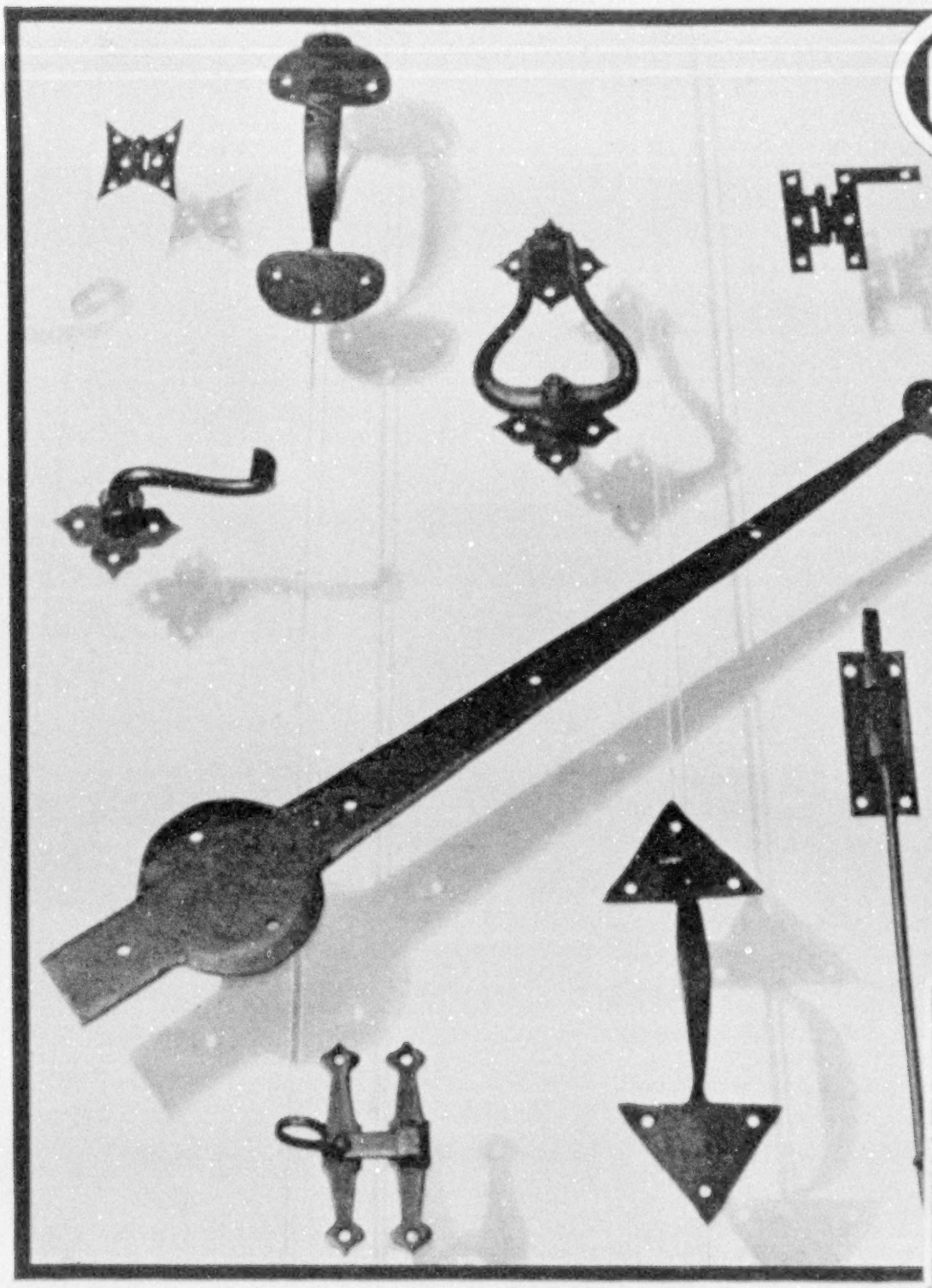

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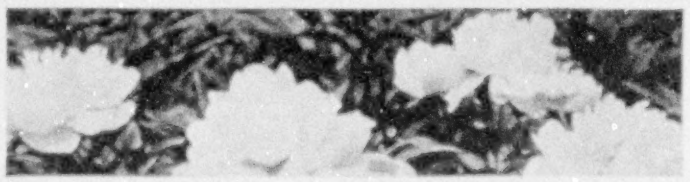

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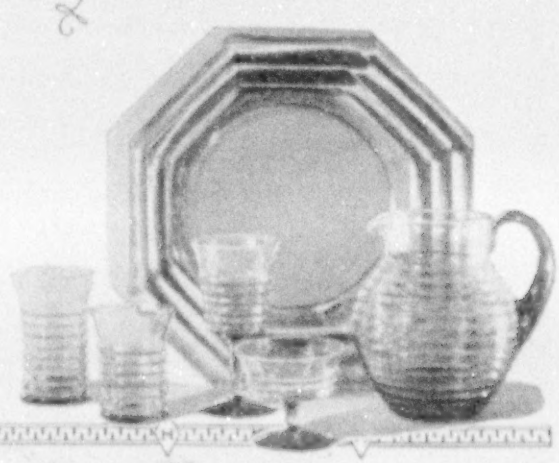
♡ A-K-J-2	♡ A-K-J-9-5-2
◇ A-K-Q-7-3	◇ A
♣ 8-4	♣ K-Q
Hand No. 14	*Hand No. 17*
♠ J-5-2	♠ J
♡ A-K-J-10-6	♡ K-9-8-2
◇ A-K-Q-7-3	◇ Q-10-9-5
♣ None	♣ J-9-6-3
Hand No. 15	*Hand No. 18*
♠ J-5-2	♠ J
♡ A-K-J-9-5-2	♡ J-9-8
◇ A-Q	◇ Q-J-9-7-3
♣ K-2	♣ 9-8-4-2

The above six hands are the third of a series of bidding problems by Milton C. Work. The dealer (your partner) has already bid one spade. The second player passes. You as the third player are asked to decide how you would bid each hand above, your partner having opened with one spade. Send your bids before Sept. 1st. Correct bids for all hands receive valuable prizes. Send bids to Bridge Contest Dept., A. H. Heisey & Co., Newark, Ohio.



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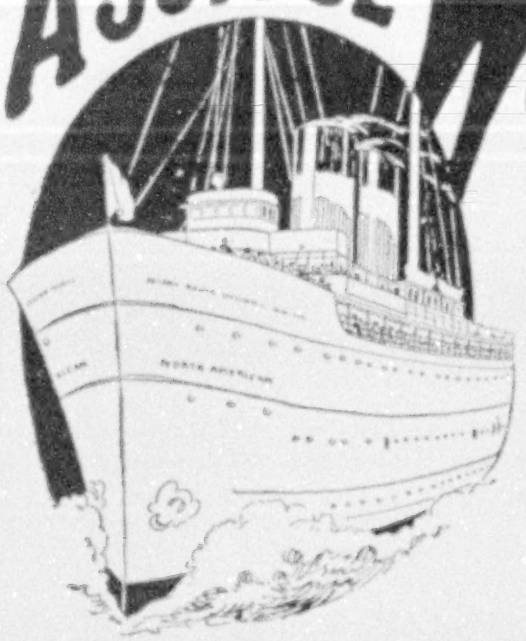

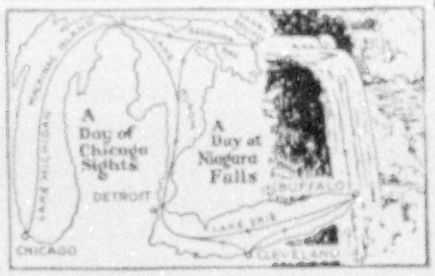

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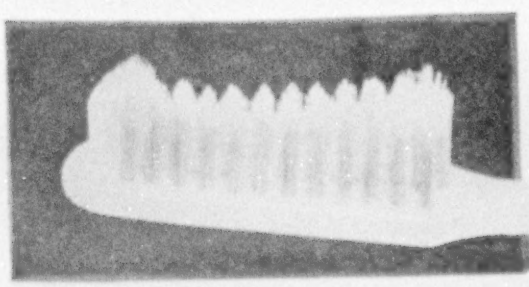

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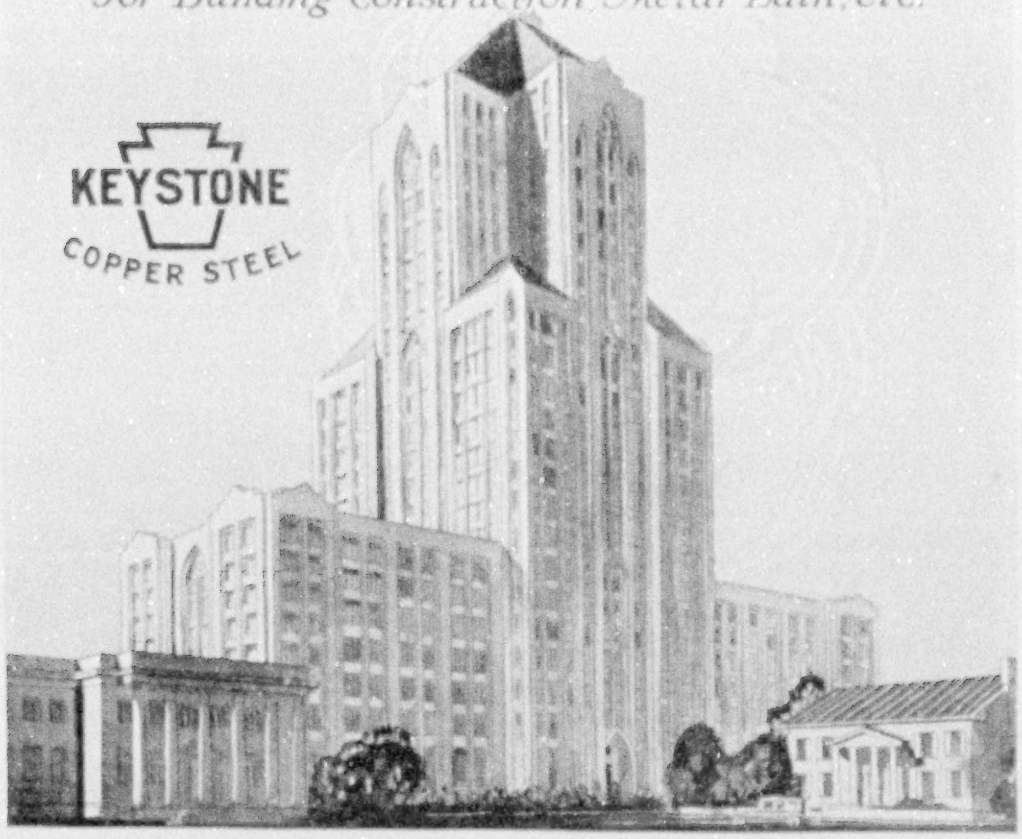

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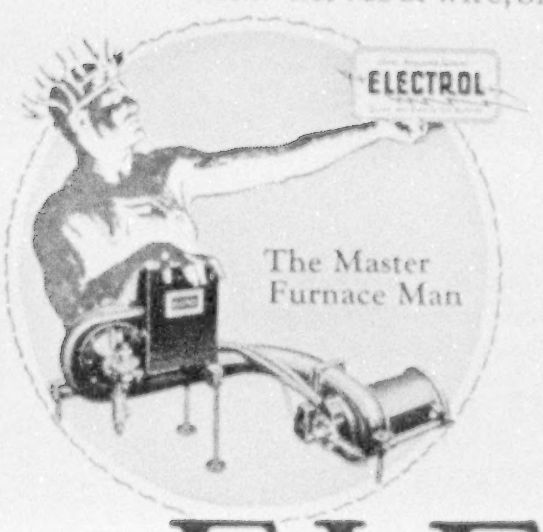

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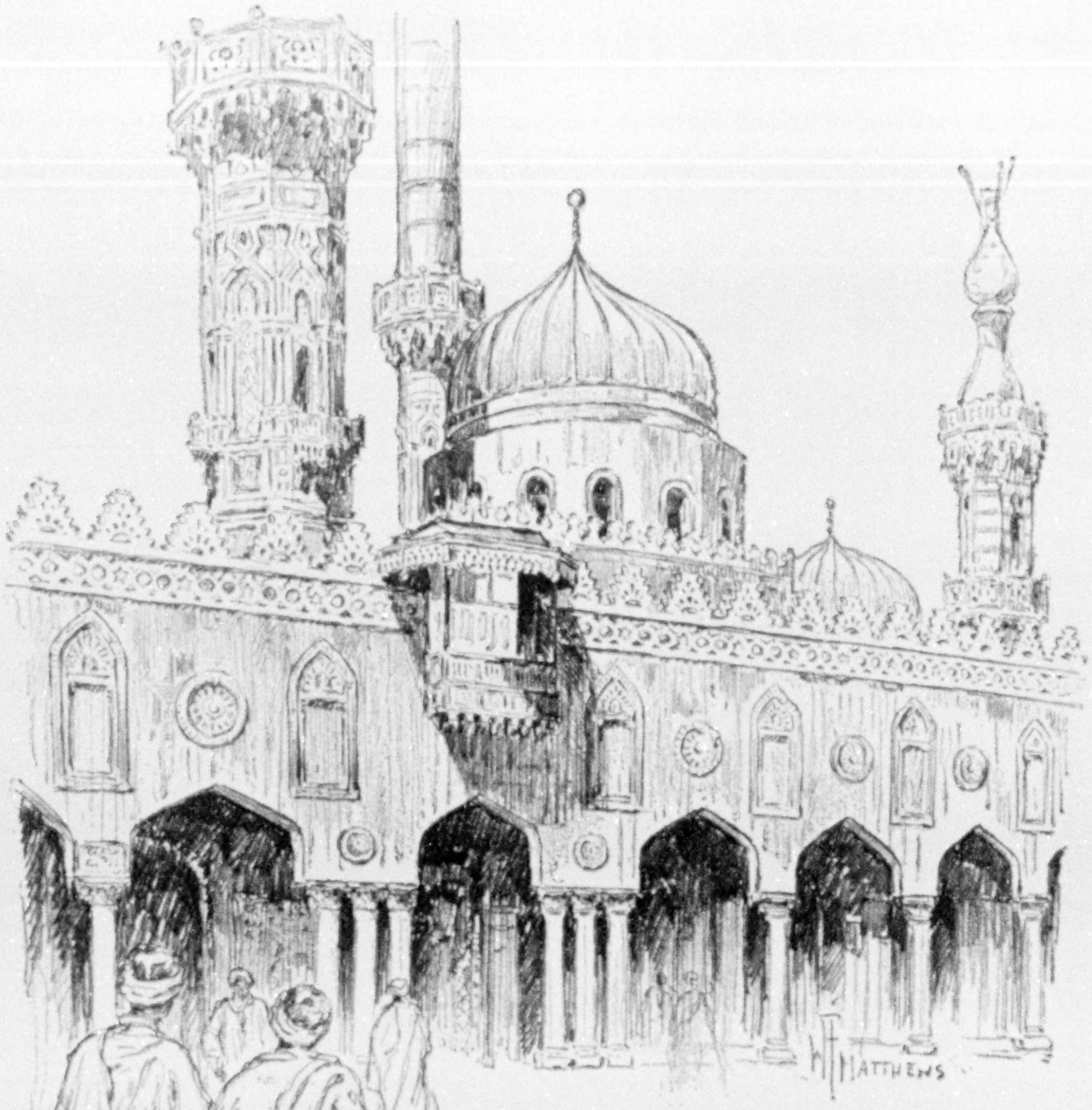

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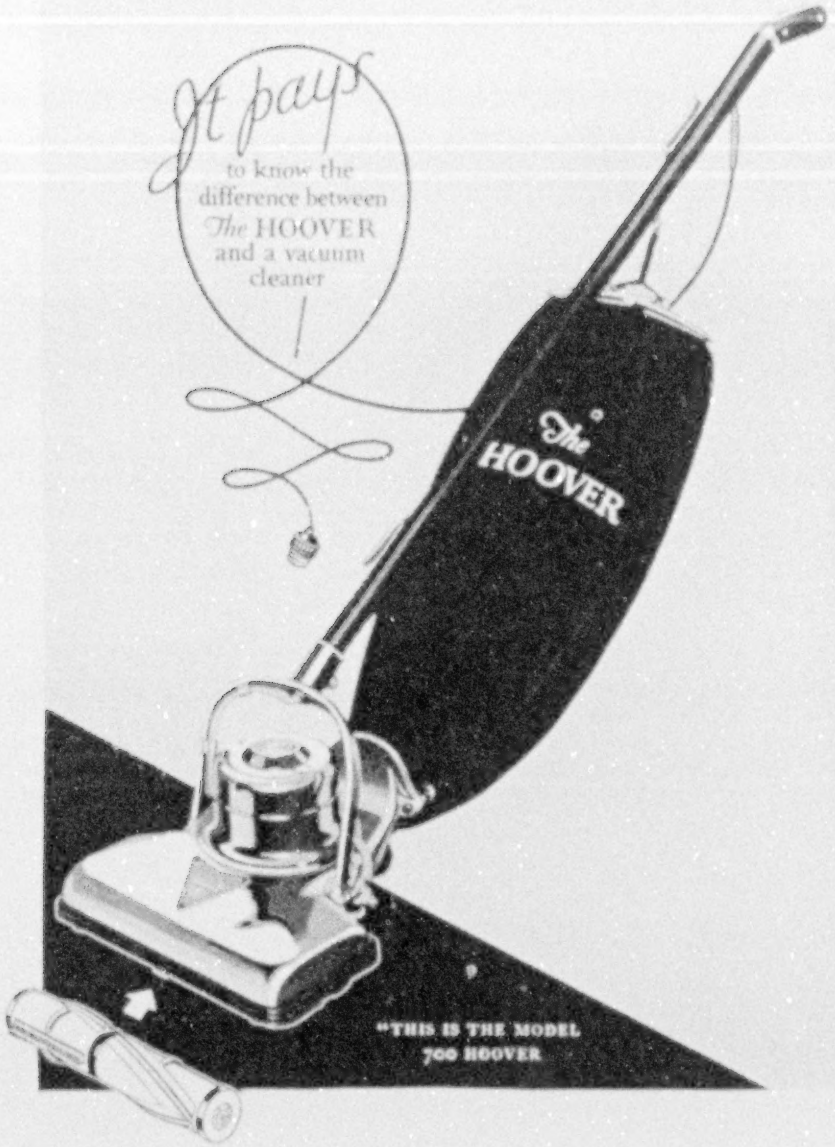

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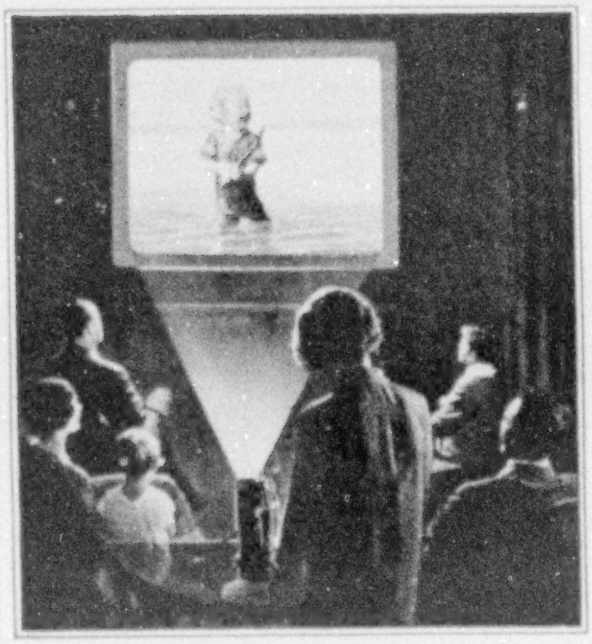

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